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DEPARTMENT OF FISH AND GAME

Jerry M. Conley, Director

FEDERAL AID IN FISH RESTORATION

Job Performance Report

Project F-71-R-12

REGIONAL FISHERIES MANAGEMENT INVESTIGATIONS

Job No. 3(MC)-a. McCall Subregion Mountain Lake Investigations
Job No. 3(MC)-b. McCall Subregion Lowland Lakes and Reservoir Investigations
Job No. 3(MC)-c. McCall Subregion Rivers and Streams Investigations
Job No. 3(MC)-d. McCall Subregion Technical Guidance
Job No. 3(MC)-e. McCall Subregion Salmon and Steelhead Investigations

By

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JOB PERFORMANCE REPORT

State of: **Idaho** **Project** **Name:** **REGIONAL FISHERY MANAGEMENT INVESTIGATIONS**

No.: **F-71-R-12**

Job No.: **3(MC)-a** **Title:** **McCall Subregion Mountain Lakes Investigations**

Period Covered: **July 1, 1987 to June 30, 1988**

ABSTRACT

In an attempt to increase the size of stunted brook trout and create diversity in mountain lake fisheries, the Idaho Department of Fish and Game (IDFG) introduced fingerling fall chinook salmon in Grassy Mountain lakes 1 and 2 in 1984 and 1986 and brown trout in Deep and Rapid lakes in 1987.

Grassy Mountain lakes were sampled in 1987. Brook trout size and condition have not changed since the introductions of chinook salmon. Additionally, few salmon have been caught and salmon condition and growth are poor. It appears that salmon introduced as fingerlings will not become effective predators on brook trout in these mountain lakes. Competition for food and space may prevent them from achieving the size necessary to become effective predators.

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INTRODUCTION

Mountain lakes in Idaho have been stocked by the IDFG with a variety of salmonids, including cutthroat, rainbow, brook, lake, brown, and golden trout and grayling. Many of the lakes were barren prior to these introductions and would again be barren if regular stocking did not occur as they lack tributary or outlet streams which most of these species need for successful reproduction. Unfortunately, where brook trout reproduction does occur in sterile alpine lakes, it often leads to stunting. Once a length of approximately 200 mm is attained in their second or third year of life, little additional growth occurs.

Grassy Mountain Lakes 1 and 2 are alpine lakes in the Little Salmon River drainage in the Payette National Forest (Figure 1) about midway between the towns of McCall and Riggins. Each is 10 to 10.5 hectares in surface area. More detailed information on location and description of these lakes are given in the 1986 annual report (Anderson et al. 1987) for the McCall Subregion.

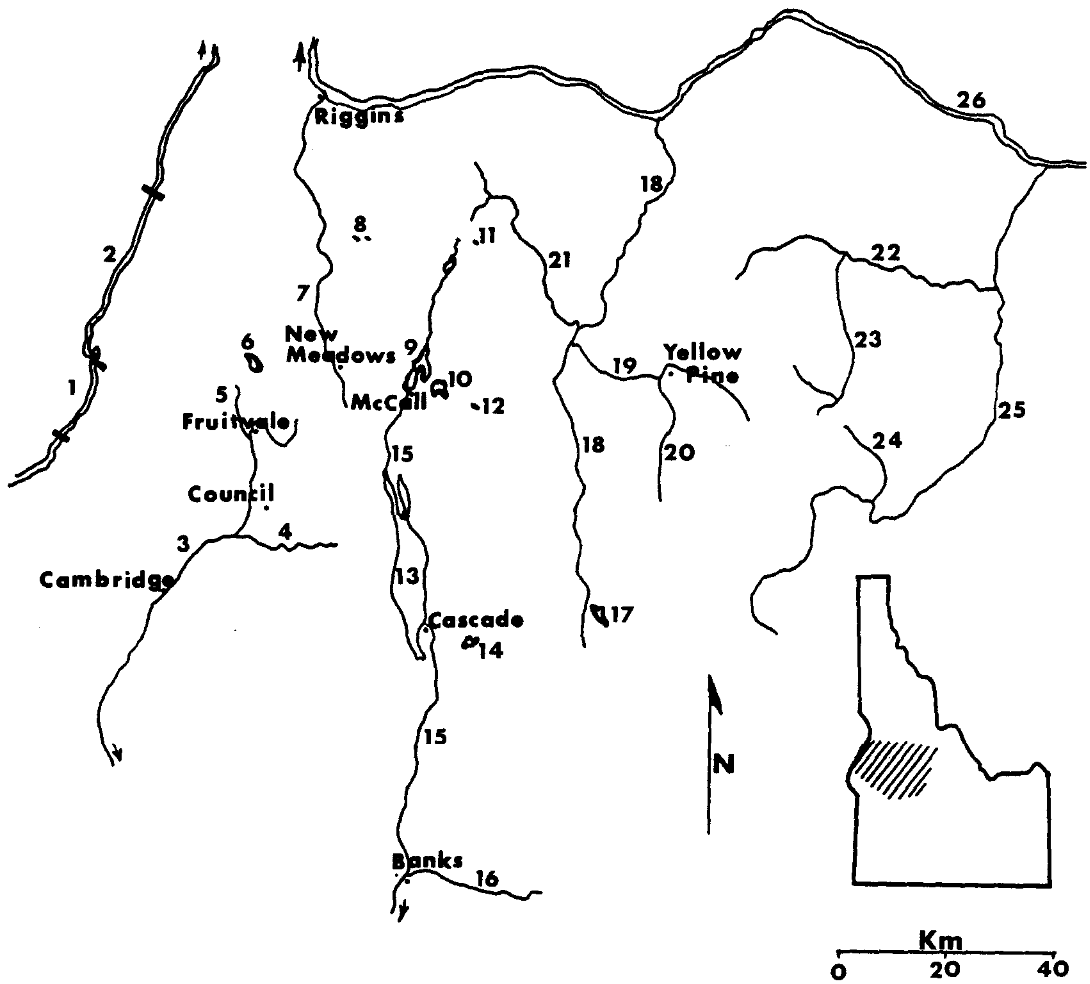
Historically, these two lakes were stocked with brook trout. They now have brook trout populations which are stunted, exhibiting poor growth and condition factor. Several attempts to establish other fish species have failed. The most recent attempt, prior to the chinook salmon introductions, was cutthroat trout fry plants in 1981. Brook trout are the only fish regularly reported caught from the Grassy Mountain lakes. These lakes were selected to evaluate the effects of fall chinook salmon on populations of stunted brook trout in mountain lakes.

In 1987, the IDFG initiated experiments with brown trout in stunted brook trout lakes. Deep and Rapid lakes, both in the upper drainage of the North Fork Payette River near the town of McCall, were selected for introduction. Deep Lake is 12 hectares in area and a 2.4-km hike from the nearest road. Rapid Lake is 5 hectares in area and 6.4 km from a road. Both lakes are at elevations near 2,250 m.

OBJECTIVES

1. To monitor the status of fish populations and fisheries in mountain lakes within the McCall Subregion.

2. To evaluate alternate species introductions as a means of improving stunted brook trout populations.



1. Oxbow Reservoir
2. Hells Canyon Reservoir
3. Weiser River
4. Middle Fork Weiser River
5. West Fork Weiser River
6. Lost Valley Reservoir
7. Little Salmon River
8. Grassy Mtn. Lakes
9. Payette Lake
10. Little Payette Lake
11. Deep Lake
12. Rapid Lake
13. Cascade Reservoir
14. Horsethief Reservoir
15. North Fork Payette River
16. South Fork Payette River
17. Warm Lake
18. South Fork Salmon River
19. East Fork South Fork Salmon River
20. Johnson Creek
21. Secesh River
22. Big Creek
23. Monumental Creek
24. Marble Creek
25. Middle Fork Salmon River
26. Salmon River

Figure 1. Major waters of the McCall Subregion including those mentioned in this report.

RECOMMENDATIONS

1. Discontinue stocking of fingerling fall chinook salmon in Idaho mountain lakes.

2. Stock brown trout again in 1988 in Deep and Rapid lakes and initiate brown trout stocking in other stunted brook trout lakes in the North Fork Payette River drainage (e.g., Trail, Skein, and Kennelly Lake 12).

3. In the summer of 1988, Deep and Rapid lakes should be sampled with rod and reel and gill nets to determine length frequency distribution and condition factor of brook and brown trout and age composition of brook trout.

4. Future evaluations should include larger brown trout for introduction (25 to 30 cm) and less domesticated stocks than the Plymouth Rock strain that is presently being used.

METHODS

In the summer of 1984, the brook trout populations of Grassy Mountain lakes 1 and 2 were sampled with rod and reel to document length frequency distribution and Fulton's condition factor (K), where:

$$K - \frac{W}{L^3} \times 10^5$$

And,

W = weight in grams, and
L = total length in millimeters.

In 1984 and 1986, fall chinook salmon were stocked in the Grassy Mountain lakes. Health of the salmon was in question in 1984, but in 1986 the salmon stocked appeared in good condition. Age, size, and density of chinook planted varied (Table 1).

Table 1. Age, size, and density of juvenile fall chinook salmon stocked in Grassy Mountain lakes 1 and 2.

		Years of age	Mean weight in grams	Density (#/hectare)
Grassy Mtn. Lake #1	1984	0+	24	48
	1986	1+	101	12
Grassy Mtn. Lake #2				
	1984	0+	24	30
	1986	1+	101	12

Each summer from 1984 through 1987, fish populations in Grassy Mountain lakes 1 and 2 have been sampled with rod and reel. Brook trout and chinook salmon lengths and weights have been recorded for analyses of length frequency distributions and condition factor. In addition to rod and reel sampling in 1987, experimental monofilament gill nets were fished overnight in the two lakes.

The brown trout stocked in Rapid and Deep lakes had been reared at Eagle Hatchery to an average size of 99 mm. The brown trout were loaded into water-filled plastic bags topped with oxygen and put into insulated foot lockers in a Forest Service helicopter. Within 15 minutes after loading, the fish were released into the lakes. One trip was made to each lake, and each received approximately 1,500 brown trout. Stocking densities were 125/hectares (50/acre) in Deep Lake and 300/hectares in Rapid Lake.

RESULTS

Grassy Mountain Lakes Fall Chinook Evaluation

Brook trout size and condition as determined from rod and reel sampling have not changed since salmon were introduced into the Grassy Mountain lakes in 1984 (Table 2). Very few chinook salmon from these lakes have been reported by anglers, and from those salmon sampled by IDFG personnel, salmon growth and condition are poor. This indicates that salmon are not preying effectively on the abundant brook trout. Salmon have had to compete with the established brook trout for invertebrate food items.

Table 2. Mean length, weight, and condition factor for brook trout sampled with rod and reel in Grassy Mountain lakes 1 and 2 from 1984 to 1987.

Grassy Mtn. lakes	Year	Length (mm)	Weight (grams)	Condition (K)	n
No. 1	1984	189	93	1.38	39
	1985	209	84	0.93	28
	1986	215	85	0.86	23
	1987	207	97	1.09	39
No. 2	1984	190	77	1.11	50
	1985	205	80	0.93	36
	1986	200	71	0.89	22
	1987	205	84	0.98	8

Gill nets captured brook trout of a similar size range as did the rod and reel, i.e., 160 to 240 mm. Additionally, a smaller size group was caught, ranging from 100 to 150 mm (Figures 2 and 3). Mean lengths, weights, and condition factors for gill net catches are presented in Table 3.

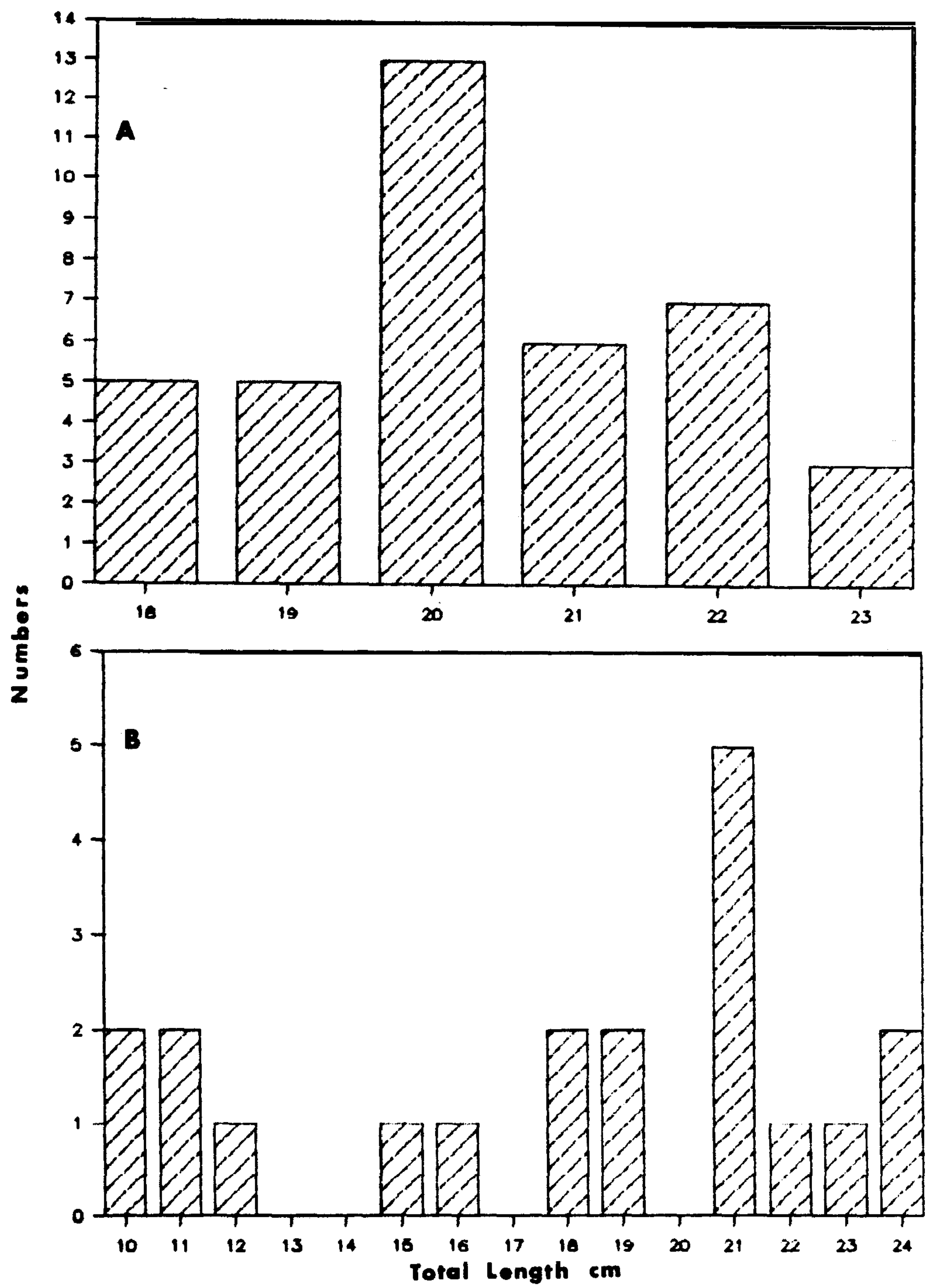


Figure 2. Length frequency distributions of brook trout caught in Grassy Mountain Lake No. 1 in 1987 with (A) rod and reel and (B) gill nets.

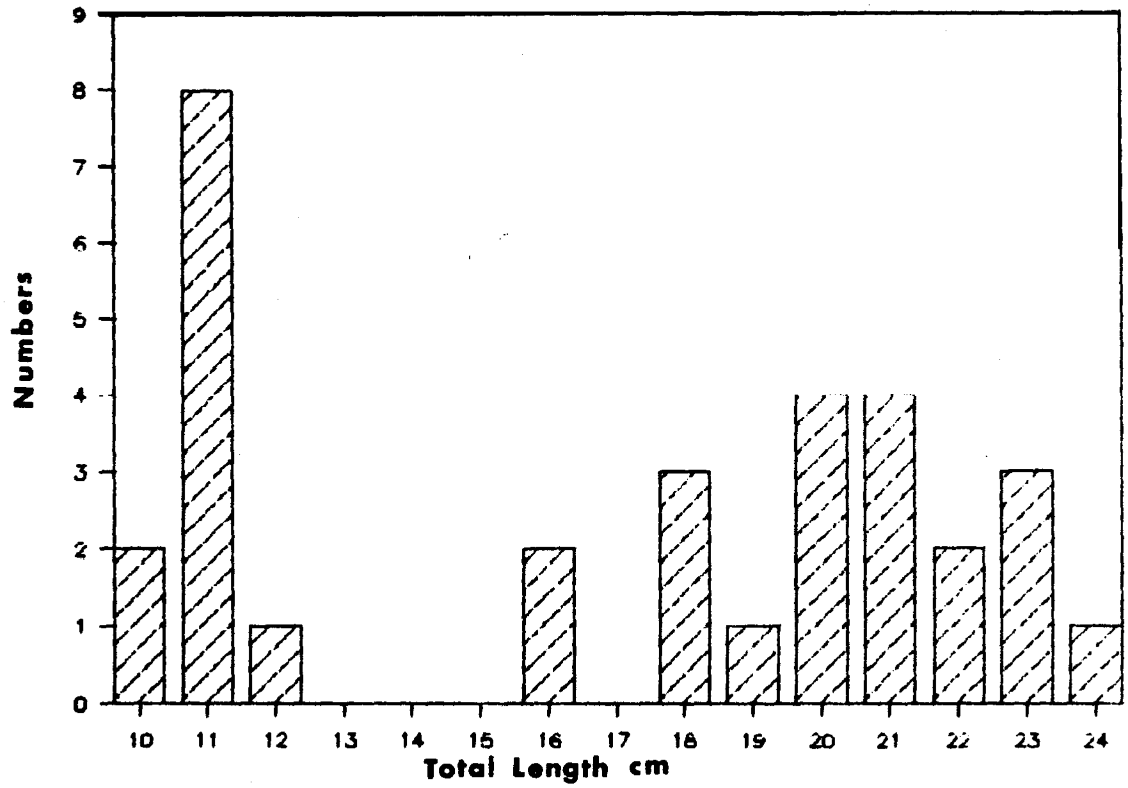


Figure 3. Length frequency distribution of brook trout caught in Grassy Mountain Lake No. 2 in 1987 with gill nets.

Table 3. Mean length, weight, and condition factor for brook trout sampled with gill nets in Grassy Mountain lakes 1 and 2 in 1987.

Grassy Mountain lakes	Length range (mm)	Mean length (mm)	Mean weight (grams)	Mean condition (K)	n
No. 1 (juveniles)	104-150	117	23	1.45	6
(adults)	160-240	208	96	1.07	14
No. 2 (juveniles)	105-120	111	20	1.45	11
(adults)	160-240	206	93	1.07	20

Few chinook salmon have been reported in the catches from the Grassy Mountain lakes. An angler brought one to the IDFG Office in McCall in 1987 which was 229 mm long. Three of the 1984 planted salmon were caught by the IDFG survey team in Lake 12 in 1985. They averaged 184 mm, about 50 mm more than when stocked a year earlier. Their average condition factor, however, was only 0.64. Chinook salmon generally live for four or five years; thus, all the 1984 stocked salmon should be dead by the fall of 1988.

The IDFG survey crew in 1987 caught only two salmon, both in gill nets at Lake 11. Their lengths were 210 and 220 mm, and each weighed 85 g; average condition factor was 0.86. Mean length, weight, and condition factor of the salmon at the time of release in 1986 were 230 mm, 101 g, and 0.83, respectively.

Although sample size is very small, the evidence indicates that the chinook salmon introductions in the Grassy Mountain lakes did not achieved the desired fishery benefits.

Deep and Rapid Lakes Brown Trout Introductions

The brown trout's success at survival, growth, and predation on brook trout in Deep and Rapid lakes will not be known until these fish have been in the lakes for one or more years.

DISCUSSION

Stocking fingerling fall chinook salmon in the Grassy Mountain lakes did not result in effective predation of salmon on brook trout. Fall chinook salmon have been effective predators on kokanee in Idaho's Coeur d'Alene lake, but the kokanee is a pelagic schooling species which chinook salmon may be able to prey on soon after the chinook salmon are stocked. The chinook salmon in Grassy Mountain lakes appeared to compete with, rather than prey on, brook trout.

JOB PERFORMANCE REPORT

State of: **Idaho**

Name: **REGIONAL FISHERY MANAGEMENT INVESTIGATIONS**

Project No.: **F-71-R-12**

Title: **McCall Subregion Lowland Lakes and Reservoirs Investigations**

Job No.: **3(MC)-b**

Period Covered: **July 1, 1987 to June 30, 1988**

ABSTRACT

A public meeting was held in McCall on April 21, 1987 to receive input on the proposed chemical rehabilitation Little Payette Lake. The proposal was supported along with a plan to manage the rehabilitated lake for trophy trout. A creel survey from May through September 1987 provided estimates of 943 hours of fishing effort, a catch rate of 0.05 trout per hour, and a catch of 49 rainbow trout. A migration barrier was constructed at the lake's outlet in August, and rotenone was applied to the lake on October 14, 1987. The majority of fish in the resulting kill were suckers, whitefish, squawfish, and kokanee. The whitefish and kokanee were stunted, averaging 16 and 15 cm in length, respectively. No trout were seen in a sample of 249 dead fish.

A creel survey on Payette Lake from May through September of 1987 provided estimates of 4,004 game fish harvested in 13,114 hours of fishing for a harvest rate of 0.31 fish per hour. Species composition in the survey was 72% rainbow trout (mostly hatchery catchables), 12% lake trout, 11% kokanee, and 6X yellow perch. The number of kokanee harvested is about 6X of the number reported in similar surveys in 1971 and 1972.

Lake trout up to 89 cm in length were recorded in the sport catch. Twelve lake trout ranging from 31 to 87 cm long were aged at 2+ to 11+ years. Six lake trout were tagged in July 1987, and one tag was subsequently reported in the sport catch.

Kokanee measured in the summer creel survey ranged from 26 to 30 cm long. On September 22, there were 7,260 early-spawning kokanee counted in the North Fork Payette River between Payette Lake and the mouth of Fisher Creek. Males and females averaged 31 cm amd 30 cm, respectively. Late-spawning kokanee were documented in gill net catches on November 4, 1986 near a gravel bar in the west arm of Payette Lake.

Kokanee stocking was discontinued in Payette Lake in 1976 after 14 years of irregular stocking. Since then, the kokanee fishery has noticeably declined. Payette Lake kokanee may be recruitment limited because the North Fork Payette River spawning grounds appear to be embedded with fine granitic materials.

A creel survey on Lost Valley Reservoir was conducted from May through September of 1987, the second summer after rotenone rehabilitation in October 1985. There were 59,323 hours of fishing effort expended to catch 25,017 rainbow trout, a catch rate of 0.45 trout per hour. Mean trout length in the harvest ranged from 36.5 cm in April to 32.4 cm in June. Trout condition appeared excellent. This high yield trout fishery supported a wide range of angler interests for boat, float tube, and bank anglers.

Gill nets set in Warm Lake on July 1, 1988 captured 56 fish, 96% of which were game fish. Most (54%), however, were mountain whitefish and are not well represented in the angler's catch. The remaining catch was 27% kokanee, 12% rainbow trout, and 41 each of brook trout and suckers. Compared with gill net catches from the 1960s, the 1987 sample had a higher percentage of kokanee and a lower percentage of whitefish, brook trout, and suckers.

Based on a measurement of chlorophyll A at the outlet of Warm Lake, the lake's trophic status is 41 on a scale of 1 to 100, with 100 being most productive.

The proportional stock densities of smallmouth bass in Oxbow and Hells Canyon reservoirs were 3.9% and 21.7%, respectively. At Oxbow Reservoir, almost all bass sampled were less than 28 cm, about 2 cm less than the minimum legal harvest size (12 inches). Mean relative weight was 87% for smallmouth bass between 14 and 28 cm total length, and conditions increased with length. The length frequency distribution of smallmouth bass was slightly larger in Hells Canyon than Oxbow Reservoir, but most fish were still smaller than the minimum size limit.

During the opening weekend of trout season at Horsethief Reservoir, May 23 and 24, 1987, angler use was 6,452 fishing hours. This is 80% of the average from 1974 through 1987, excluding 1981 when only catch rate was estimated. Total harvest was 4,502 trout, which was 91% of the average since 1974. As usual, most of the use (60%) and harvest (77%) occurred on the opening day. The average length of trout harvested during the census period was 305 mm, compared to 294 mm in 1986, and 277 mm in 1985.

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INTRODUCTION

Little Payette Lake (LPL) is a natural, glacially formed lake located three miles east of McCall along the Lick Creek Road (Figure 1, Job a). It is part of the Lake Fork Creek system and is 24 km upstream from Lake Fork Creek's confluence with the North Fork Payette River. Irrigators increased LPL's surface area from 196 hectares to 587 hectares in 1926 by construction of a 6-m high dam. Two-thirds of the lake, when full, is on a shallow, flooded plain 2 to 3 m in depth. The lake's elevation is 1,554 m, total dissolved solids are 22 mg/l, average depth is 6.1 m, and the morphoedaphic index is 1.1. LPL drains 164 sq km, much of which is steep, forested land rising up to peaks of over 2,500 m in elevation.

The LPL fishery has a history of nongame fish problems, mainly northern squawfish and largescale suckers. The IDFG poisoned the lake in 1971 with antimycin and restocked in 1972 with rainbow trout and kokanee (Welsh 1973). "Excellent" fishing was reported in the years immediately after treatment. Comparative catch rates from creel surveys done the year prior to and the year immediately after chemical treatment do not demonstrate much change, however. Catch rate for game fish in 1971 was 0.9 fish per hour (581 kokanee and 421 rainbow trout) and 1.0 fish per hour in 1972 (1001 rainbow trout). Size of trout two to three years after the rehabilitation were reported to commonly reach 40 to 45 cm, much larger than would occur if catchable size rainbow trout were stocked among a community of stunted fish.

The catch rate measured in a limited survey in 1980 was 0.3 fish per hour (rainbow trout and whitefish). Experimental gill nets in 1984, 1985, and 1986 were between 921 and 951 suckers and squawfish. Catchable rainbow trout stocked in the lake did not grow or survive from one summer to the next.

Big Payette Lake, more commonly called Payette Lake, is one of three Payette lakes (the other two are Little Payette Lake and Upper Payette Lake) in west-central Idaho near McCall (Figure 1, Job a). Payette Lake is highly visible, with Highway 55 paralleling its shoreline for more than 3 km within the tourist community of McCall. Additionally, the lake is very scenic, with crystal clear water (transparency 5 to 7 m) and a steep forested watershed rising several thousand feet to peaks which generally remain snow capped for nine to ten months of the year.

The lake is in a glacially formed granitic basin, has a surface area of 1,958 hectares, and is at an elevation of 1,524 m. Lake volume is 61,676 hectare meters, and average depth is 31.5 m. Annual variation in height is 1.5 to 1.8 m, which corresponds to a volume change of 3,577 hectare meters, less than 61 of total volume (Falter 1984). Release of this stored water is controlled by the Lake-Reservoir Irrigation Company. The company saves most of the water through the summer and releases it in the fall.

Welsh (1985) presented a detailed history of Payette Lake's fisheries. In summary, Payette Lake received large (75,000 plus) runs of sockeye salmon prior to the intensification of commercial salmon canning operations on the lower Columbia River in the 1880s. Sockeye runs were eliminated by a diversion dam on the lower Payette River about 1908.

Native game fish were kokanee and mountain whitefish. Introduced game fish include rainbow trout, Gerrard rainbow trout, lake trout, yellow perch, and early and late-spawning kokanee salmon.

Efforts to enhance kokanee populations through hatchery propagation began in the 1930s. Late-spawning kokanee from northern Idaho were stocked in Payette Lake between 1962 and 1968. This race of kokanee was not used after 1968 as it was determined that the spawning streams were too cold when late spawning must occur.

Early-spawning kokanee were stocked in 1969, 1970, 1971, 1975, and 1976 after which time kokanee stocking was discontinued. In years that kokanee were stocked, the average release was 144,000.

Gerrard rainbow trout were first introduced into Payette Lake in 1946. Rainbow trout stocked since 1975 have generally been unspecified rainbow catchables, an average of 20,470 per year. These fish are stocked at several locations around the lake and at several times from May to August.

Lake trout from Canada were first introduced into Payette Lake in 1955, and they have been stocked in 23 of the 33 years since then. The last year they were stocked was 1985, and they may not be stocked in the future if it can be determined that they are successfully reproducing in Payette Lake. Lake trout were stocked as 15 to 18 cm subcatchables most years, but more recently they have been stocked as fry.

Lost Valley Reservoir is a 256-hectare impoundment on Lost Creek in Adams County (Figure 1, Job a) which was constructed in 1910 for irrigation storage. It lies in a flat valley and when drawn down, the surface area is greatly reduced. At full pool, the flat area is relatively shallow, less than 3 m, and extensive beds of submerged pondweed (Potamogeton) form. The Lost Creek drainage is mostly basalt leading to more productive water (total dissolved solids are 48 mg/1) than in the North Fork Payette drainage lakes. Elevation is 1,451 m, and the reservoir is ice covered about 4 months each year.

Lost Valley Reservoir was treated with rotenone in October 1985 to rid the reservoir of an overpopulation of stunted yellow perch. The reservoir was restocked with rainbow trout of several sizes and strains in spring and summer of 1986, and a good trout fishery was reported by anglers that summer.

Warm Lake is a scenic, 259-hectare natural water body lying at a 1,615 m elevation in the upper South Fork Salmon River valley in Valley County, 50 km east of Cascade (Figure 1, Job a). A paved road coming from Cascade passes within 2 km of the lake, much of the lakeside is developed with private cabins, and there are two lakeside resorts featuring cabins, restaurants, and boat rentals. Additionally, the Forest Service has provided nearby camping facilities, which are heavily used. The lake has a popular fishery and an active Warm Lake Users' Association.

Oxbow and Hells Canyon reservoirs are main stem impoundments of the Snake River located in Adams County along Idaho's border with Oregon (Figure 1, Job a). They were created in 1961 and 1967, respectively, and have respective surface areas of 465 and 1,012 hectares. The reservoirs lie adjacent to each other within the Hells Canyon reach of the Snake River. They are narrow reservoirs with generally steep sides. Oxbow is upriver from Hells Canyon Reservoir and is immediately downstream from Brownlee Reservoir, which is four times larger than the combined area of Oxbow and Hells Canyon reservoirs. The effects of the upper reservoir on the two lower ones are to reduce temperature fluctuations and reduce transport of suspended matter. Additionally, Oxbow Reservoir serves as a re-regulating reservoir for power peaking at Brownlee Dam, resulting in more frequent water level fluctuations in Oxbow Reservoir than in Hells Canyon Reservoir.

Recent studies of bass populations in Idaho lakes and reservoirs (Rieman 1984; Rohrer 1984; Rohrer and Chandler 1985) have found that mortality rates are often high, and fishing mortality is the most significant part of total mortality. To offset declining quality of bass populations, a general 12-inch (30.5 cm) minimum size limit on bass was established in Idaho in 1986. Rohrer and Chandler (1985) recommended an even more conservative 14-inch (35.5 cm) minimum size limit, at least for Brownlee Reservoir.

Horsethief Reservoir is a 110-hectare impoundment about 12 km east of Cascade, Idaho (Figure 1, Job a). It is owned and managed by the IDFG for fishing and outdoor recreation. The dam was built on Horsethief Creek in 1973 using Dingell-Johnson funds for fisheries development. The reservoir supports a very popular fishery, with many family groups visiting the area. Memorial Day Weekend is associated with the annual opening of the fishing season, and this has been the time of heaviest fishing pressure at the reservoir.

Fishing quality declined from the excellent fishing provided in the initial years of impoundment and required rotenone rehabilitation in 1983 to eliminate yellow perch. Since then, fishing has been stable and of good quality, and it is expected to remain so in future years.

OBJECTIVES

Little Payette Lake

1. To present preferred fisheries management alternatives to the public.

2. To construct a migration barrier at the outlet of Little Payette Lake to prevent the re-establishment of nongame fish.

3. To chemically rehabilitate Little Payette Lake.

4. To determine fishing effort, catch per unit effort, and catch in the summer prior to lake rehabilitation as a basis for future comparisons.

(Big) Payette Lake

1. To estimate harvest, catch rate, and fishing effort.
2. To document the size distribution and relative abundance of early-spawning kokanee spawners.
3. To document the size and age distribution of lake trout.
4. To estimate lake trout population size and rate of exploitation.

Lost Valley Reservoir

1. To estimate fishing effort, catch rate, and catch during the second year after rotenone rehabilitation.
2. To determine the relative contribution of the various strains of rainbow trout stocked in 1986.

Warm Lake

1. To obtain current fish population and limnological information.

Oxbow and Hells Canyon Reservoirs

1. To monitor the age, growth, condition, and size structure of smallmouth bass populations in Hells Canyon and Oxbow reservoirs following implementation of a 12-inch minimum size limit.

RECOMMENDATIONS

Little Payette Lake

1. Little Payette Lake should be managed for trophy trout with a two-trout over 20 inches creel limit, general season, and single barbless hook tackle restrictions.
2. Catchable size domestic Kamloops and fingerling wild rainbow trout from Pennask Lake, British Columbia, should each be stocked at 17 per hectare in the spring of 1988.
3. *Gammarus* should be introduced in an attempt to improve the forage base.

4. The boat launching facilities should be improved to allow for increased use.

5. Spot checks of catch rate, fish size, and condition should be conducted in late summer and fall of 1988 to determine if trout survival and growth are conducive to development of a trophy fishery.

Payette Lake

1. Kokanee should be stocked in Payette Lake at about 350,000 fry per year. All should be tetracycline marked so the relative contribution of stocked kokanee can be determined in future surveys.

2. The quality and quantity of available spawning gravel in the North Fork Payette River above Payette Lake should be described.

3. Kokanee standing crop, age distribution, and growth rate should be estimated and compared with the 1980 estimates of Bowler and with future estimates after enhancement with hatchery-reared kokanee fry.

4. Estimate zooplankton species composition and size distribution before and after kokanee enhancement. This would also provide an opportunity to look for the presence of *Mysis* shrimp.

5. Conduct a summer creel survey in 1988 similar to that done in 1987, but with increased angler counts and interviews. The 1987 and 1988 survey data will provide a base for comparision with fishery statistics after the planned fishery enhancements at Payette Lake have taken effect.

6. Conduct a series of kokanee spawning ground counts in the North Fork Payette River and look for late-spawning kokanee spawning areas using SCUBA.

7. Put 20 to 90 mm gravel in selected shoreline areas as was done at Coeur d'Alene (Bennett and Hassemer 1982) and determine if it is used by late-spawning kokanee.

8. Determine timing of summer's first significant plankton bloom as a basis for scheduling kokanee and trout stocking.

9. To determine population size, rate of exploitation, and distribution of lake trout, fish should be collected with gill nets. Tagging should be done in spring and fall of 1988 until sufficient returns are obtained to estimate population size. Rate of exploitation will be determined from angler returns of the $5.00 reward tags.

10. All lake trout collected in 1988 should be aged to add to the limited age and growth data obtained in 1987.

11. Small mesh gill nets should be fished in various habitats and seasons to determine if natural reproduction of lake trout has occurred since lake trout stocking was discontinued in 1985.

12. To determine the relative utilization by lake trout of available species in Payette Lake, lake trout stomach contents should be examined whenever available.

13. Lengths and weights should be measured from a large sample of lake trout to determine which size classes, if any, appear to have a limited food supply and to have a baseline relationship for future comparisons.

Lost Valley Reservoir

1. Fifty to 100 trout should be measured and stomach contents examined to document the length frequency distribution for annual trend data and to determine what food sources are being used.

2. Gill net stations should be established for annual trend data on species and size composition. This information will document when and to what extent fish other than rainbow trout are invading the reservoir and what effect they are having on trout growth.

3. Catchable size, as well as juvenile trout, should be stocked to better use the abundant snail population as a forage base.

Warm Lake

1. Continue stocking 15,000 to 16,000 hatchery catchable rainbow trout annually. Stocking should be done in three loads, just prior to the Memorial Day (50Z), Fourth of July (25%), and Labor Day (25%) holidays. Special strains of catchables should be stocked, when available, and their relative contribution to the catch and ability to overwinter should be evaluated.

2. A creel survey should be done to evaluate the return of hatchery catchables to the creel, relative use of the lake by cabin residents and infrequent visitors, relative species and size composition in the catch, as well as estimates of fishing effort, catch rate, and catch.

3. Length frequency of kokanee spawners should be recorded to compare with information from 1960 prior to termination of kokanee stocking.

Oxbow and Hells Canyon Reservoirs

1. Determine the age structure and growth rate of smallmouth bass.

Horsethief Reservoir

1. Continue to stock 50,000 fingerling rainbow trout (455/hectare) annually in Horsethief Reservoir. Kamloops, Mt. Lassen, or other domesticated strains should be used to obtain maximum first-year growth.
2. Monitor the 1988 Memorial Day Weekend fishery to determine the effects of the newly implemented year-round season on Horsethief Reservoir.

METHODS

The IDFG solicited input for Little Payette Lake fishery management at a public meeting in McCall and through correspondence. The IDFG engineering crew modified Lake Fork Creek at the outlet of LPL using dynamite and cement such that a fish migration barrier was created. IDFG fisheries personnel and local conservation officers, assisted by Utah Division of Wildlife staff and their two rotenone distribution barges, applied rotenone to LPL to poison the fish populations.

Creel surveys were conducted at Little Payette and Big Payette lakes and at Lost Valley Reservoir from May through September. The survey period was divided into monthly time blocks, and each block was stratified by weekends (and holidays) and weekdays (Malvestuto 1985). Expanded estimates of catch and fishing effort were based on up to five survey days per time block in which one angler count and a series of interviews were made. Days surveyed and whether counts occurred in the a.m. or p.m. were randomly selected. The fishing day was considered to be the average time interval between sunrise and sunset within each time block.

Additionally, on Payette Lake anglers were given postcards and requested to send in completed fishing trip information on catch and fishing effort.

During September, spawning kokanee were counted in the North Fork Payette River from the mouth of Fisher Creek down to where Payette Lake begins to affect stream flow, and fifty spawners were measured from this area.

Scales were taken and lengths recorded from lake trout captured by angler and fisheries personnel at Payette Lake. Length frequency distribution and age in the lake trout catch were determined from these data.

Using midsummer angling techniques used for catching lake trout in northern Idaho's Priest Lake, six lake trout were captured and tagged with Floy anchor tags. The tags stated that $5.00 would be given for the return of a tag to the IDFG.

On July 1, IDFG personnel set four experimental gill nets overnight in Warm Lake. Two nets were set at the surface, one was suspended at 9 m, and one was set on the lake bottom at 12 m. Each fish in the catch was measured and identified by species.

Water temperatures and dissolved oxygen concentrations at several locations were recorded at 1-m intervals from surface to 18 m with **a** Yellow Springs Instrument **(YSI)** water quality meter.

On August 12, water samples were taken from Warm Lake to the Idaho Department of Health and Welfare Laboratory in Boise for analysis of total dissolved solids, total nitrates, total phosphates, and chlorophyll A. Composite samples were taken in the inlet area, outlet area, and from the epilimnion and hypolimnion of the midlake area. Chlorophyll A was used to estimate the lake's trophic status index (Carlson 1977).

On May 11-12 and May 14-15, Hells Canyon and Oxbow reservoirs were sampled, respectively. Rod and reel sampling was done on the afternoon of the arrival day, electrofishing was done that night, and we returned to McCall the following day. Rod and reel sampling was done with artificial lures, mainly lead-headed jigs, near shoreline structures; and electrofishing was done with a Coffelt model VVP-2c, 2,000-watt variable voltage pulsator operated from a double boom-mounted, 16-ft. john boat. Electrofishing was done in a continuous line along the shore, with selection for particular habitat type. All fish were measured in millimeters and released into the reservoir. At Oxbow Reservoir, bass were weighed to the nearest 5 g. We did not weigh fish at Hells Canyon Reservoir.

Additionally, we gave data forms to a Boise-based bass club, and club members provided length data on all bass caught during their bass tournament practices at Hells Canyon Reservoir. A fishing outfitter provided similar data from Oxbow Reservoir.

On opening day at Horsethief Reservoir, the Idaho Department of Fish and Game personnel conducted angler counts spaced at two-hour intervals from 0730 to 1930 and counted bank, boat, and float tube anglers. Binoculars and a spotting scope were used to make counts from three locations around the lake. Anglers were interviewed between counts to 'record the hours they fished and the number of fish caught. Species composition and the size of fish caught also were recorded.

Total daily use (fishing effort in hours) was calculated from the following formula:

$$TU = A \times DH$$

Where,

TU = total use,
A = average angler use per count, and
DH = daylight hours.

RESULTS

Little Payette Lake

On April 21, 1987, **a** public meeting attended by 43 people was held in McCall to discuss fisheries management on Little Payette Lake. The meeting and written comments provided strong support for poisoning the fish in LPL followed by trophy trout management with restrictive creel and size limits.

In August 1987, the IDFG engineering crew constructed a migration barrier immediately downstream from the spillway outlet of LPL in Lake Fork Creek. This structure will create a steep falls which should stop unwanted fish from migrating upstream from Cascade Reservoir and into LPL. Additionally, the velocity of water exiting the lake through the low water outlet pipe was measured. Velocities ranged from 3.3 to 5.5 m/sec and are assumed to be sufficient to block upstream migration.

When drawn down to base volume, LPL contains about 2,220.5 hectare meters (18,000 acre feet) of water. We treated the lake with 15,536 kg of cube powder, producing a 1 ppm solution of 5% active rotenone. Most of the powder was mixed in a cement truck, poured as a slurry into 3,030 and 3,785-liter tanks on barges, then poured into the propeller wash as the barges traveled across the lake. About 10% of the powder was applied by dragging 23-kg bags of powder behind boats, allowing water to enter the bags, mix, and dissolve the powder. The powder was applied by a crew of 29 people in about 12 hours beginning at 10 a.m., after 3 hours of start up problems. Number of people for the task included: barge operators (4), bag cutters (6, as 3 replacement teams of 2 each), bag haulers from the warehouse to the lakeshore (6), small boat operators (6, in 2 boats spraying liquid rotenone in shallow areas and applying powder from 23-kg bags), cement truck operation (1), batch mixing coordinator (1), backhoe operator (1), drip station operators (3), and a roving assistant (1). Two persons also volunteered to collect a sample of dead fish for examination and to take photographs.

In addition to the powdered rotenone, we sprayed 380 liters (5% active ingredient) of liquid rotenone across shallow areas of the lake and dripped 265 liters into tributary streams. Lake Fork Creek up to the inlet of Brown's Pond, approximately 7 km above LPL, was treated with at least 3 ppm rotenone liquid for 5 consecutive days beginning October 13, the day prior to lake treatment. Side tributaries to Lake Fork Creek were treated with at least 3 ppm rotenone for several hours. The distance up tributaries where treatment began was believed to be above where catostomids and cyprinids occurred.

We established a potassium permanganate ($KMnO_4$) drip station immediately downstream from the lake's outlet. It was not effective, however, in part because uneven mixing of the rotenone in the first hours after application may have produced an effluent with a rotenone concentration higher then that used in the neutralizing $KMnO_4$ solution.

After five days, the $KMnO_4$ drip was discontinued. The lake's effluent remained toxic to fish for at least one month after treatment because fish were killed down to Lake Fork Creek's entrance into Cascade Reservoir on November 13. Lake Fork Creek's water, which until then had been diverted, was directed back into the stream. Average water temperature in LPL during the month after rotenone application was near 5°C. At these temperatures, the rotenone should have lost its toxicity to fish in 36 to 38 days (Davies and Shelton 1985).

A 245 fish sample of windrowed dead fish from LPL two days after the rotenone poisoning was examined for species composition and size distribution. Species composition was: 45% suckers, 25% whitefish, 15% squawfish, 13% kokanee, and 2% shiners. Size distribution is shown in Table 1. All populations were stunted in size, and the kokanee and whitefish were generally too small to be of value in a fishery. Three weeks after the rotenone application, we observed that three distinct windrows of dead fish were on the shore of LPL. The upper row was as described in the fish sample above. The middle row contained mainly age 0 fish of mixed species, and the lower row (last row to be formed) was mainly squawfish, a large part of which were mature fish. Examination of the windrowed fish revealed that there were more whitefish and kokanee than the past three years' gill net data had shown, but the rotenone and gill net data both showed that trout were rare in LPL.

Table 1. Species and size composition of dead fish windrowed on the shore of Little Payette Lake two days after rotenone application.

Species	Mean length	Standard deviation	Length range	
Suckers	21 cm	4.0 cm	9-32 cm	111
Whitefish	16 cm	5.3 cm	8-25 cm	62
Squawfish	17 cm	4.5 cm	12-26 cm	36
Kokanee	15 cm	2.3 cm	12-23 cm	31
Shiners	7 cm		7-7 cm	5

Experimental gill nets were set overnight in LPL two weeks after rotenone treatment at depths from 3 to 20 m and in various parts of the lake. No fish were caught.

Rotenone is also toxic to zooplankton (Bradbury 1986), and it is assumed that most copepods and cladocerans were killed in Little Payette Lake. In Washington lakes, the crustacean-free period is usually two to twelve weeks. However, Bradbury also noted that plankton recovery was slower in relatively sterile alpine lakes than in nutrient-rich lowland lakes. Extreme crustacean-free periods after rotenone treatment of 6-9 months have been recorded. Restocking of Little Payette with trout is scheduled for late May 1988, about seven and one-half months after rotenone treatment. Plankton availability will be determined prior to fish stocking.

We estimated that 943 hours of fishing effort were expended at LPL during the five-month interval of May through September 1987. Catch of game fish, 49 rainbow trout, was negligible. The catch rate was 0.05 trout per hour (Table 2).

Table 2. Number of days surveyed on weekdays (WD) and weekend (WE) days, hours of fishing effort, catch rate, and catch by month during the summer of 1987 at Little Payette Lake.

	Survey days		Effort	Catch per	Catch (i
Month	WD	WE	(hours)	hour	of fish)
May	2	3	147	0.33	49
June	1	2	169	0	0
July	3	2	534	0	0
August	3	2	93	0	0
September	1	1	0		0
Totals	10	10	943	0.05[a]	49

[a]Equals total catch divided by total effort.

Fishing effort may have been lower than usual because west-central Idaho media had informed the public concerning the upcoming rotenone treatment of LPL in the fall of 1987. People were aware that fishing was considered poor in LPL. Nevertheless, had catch rates been acceptable, more effort would have occurred.

Payette Lake

During the five-month survey season on Payette Lake, an estimated 4,004 game fish were harvested in 13,114 hours of fishing effort, for an average catch rate of 0.31 game fish per hour (Table 3). Effort was evenly distributed through the months of May through August and decreased to about one-third that level in September.

The average count of anglers on the lake during the survey contained 6.7 (882) boat anglers and 0.9 (122) bank anglers. Targeted species, according to 67 anglers responding to the question, were: 39% anything, 30% lake trout, 19% rainbow trout, and 13% kokanee.

Table 3. Summer 1987 creel survey estimates of fishing effort, catch rate, and catch from Payette Lake.

	Effort	Catch rate	Catch	Days surveyed	
Month	(hours)	(fish/hour)	(numbers)	WE	WD
May	3,578	0.16	530	3	2
June	2,274	0.27	684	1	2
July	3,140	0.24	949	2	3
August	3,147	0.61	1,640	3	2
September	975	0.27	201	1	1
Totals	13,114		4,004	10	10
Mean		0.31			

Almost two-thirds of the catch (64%) were hatchery catchable rainbow trout. The remaining catch was divided among lake trout (12%), kokanee (11%), natural rainbow trout (8%), and perch (6%) (Table 4). Return to the creel of the 17,184 hatchery catchable rainbow trout stocked in 1987 was 15%. Average lengths of each species in the creel were 28 cm for both hatchery and natural rainbow trout, 27 cm for kokanee, and 57 cm for lake trout.

Table 4. Relative species composition of game fish caught in the summer 1987 creel survey on Payette Lake.

Month	Hatchery rainbow trout	Natural rainbow trout	Lake trout	Yellow perch	Kokanee salmon
May	133	133	265	-	-
June	171	171		86	256
July	614	-	-	167	167
August	1,435	-	205	-	-
September	201	-	-	-	-
Totals	2,554	304	470	253	424
	64%	8%	12%	6%	11%

The number of anglers encountered during the surveys was always small. In an attempt to obtain more information, anglers were given a self-addressed postcard on which information was requested concerning fishing effort and catch for the completed day of fishing. Nineteen completed postcards were returned representing 88 hours of effort, mainly from the months of June through August. The average catch rate for game fish was 0.59 fish per hour. The species composition was 52% rainbow trout, 38% kokanee, and 10% lake trout.

The catch rate was nearly twice as great as estimated from direct interviews, and the relative composition of rainbow trout and kokanee were considerably different. Possible reasons for the differences were:

1. That successful anglers are most likely to complete the questionnaire and mail it.

2. That anglers misunderstood the question as to hours fished, which should have been read hours times number of fishermen, but may have been interpreted simply as hours.

3. That anglers believed that some of the open water rainbow trout, which were likely to have been very silver in color, were kokanee.

Unless the biases from postcard surveys can be identified and adjusted for, the information should be used with caution, if at all.

During the summer of 1986 (June through August), anglers brought twelve lake trout to the McCall IDFG Office for examination. In 1987, IDFG personnel captured and measured nine lake trout, and one angler provided lake trout scales, stomachs, and lengths from four fish. Additionally, two lake trout were measured in the summer creel survey. The length frequency distribution of these 26 lake trout is shown in Figure 1. Their average size was 70.4 cm (27.7 inches), with 12 (46%) at least 76 cm (30 inches) long and the longest 88.9 cm.

Stomach contents were examined from a 31 cm and 35 cm lake trout captured on July 7, 1987. Both fish contained mostly digested fish (approximately 4-cm long) and invertebrate parts, possibly dragonfly larvae. The lake trout appeared very thin in contrast to the condition of the larger lake trout captured. Stomachs of two large lake trout (84 and 85 cm) captured on November 4, 1987 contained only fish. Of six partially digested fish from the two stomachs, two were identified as kokanee, each approximately 25 cm in length. The other fish were not kokanee, as determined by their whitish flesh, and they were thicker and slightly longer than the kokanee. Further identification was not possible.

Six of the lake trout captured by IDFG personnel in July 1987 were tagged with $5.00 reward tags and released. One of the tagged fish was subsequently captured by a sportsman.

Annuli were counted on scales of 12 lake trout collected during the summers of 1986 and 1987. Trout lengths ranged from 31 to 87 cm, and ages ranged from 2+ to 11+.

Only five kokanee, captured between June 7 and July 14, were measured during the creel survey. They ranged.from 26 to 30 cm in length. Fifty kokanee were captured and measured at spawning sites in the North Fork Payette River (NFPR) above Payette Lake on September 25, 1987. Average length of males was 31.3 cm, and average length of females was 30.0 cm. On September 22, 1987, IDFG personnel walked the kokanee spawning area in the NFPR above Payette Lake and counted 7,260 kokanee spawners.

On November 4, 1986, 19 prespawning kokanee were captured in a gill net over a gravel bar near shore. An external grey-red color and well-developed gonads indicated that they would soon spawn. Kokanee in this stage of sexual maturity this late in the year must be from the late-spawning strain. They probably would have spawned in the lake rather than in inlet streams. Their average total length was 30.3 cm and ranged from 28.4 to 32.1 cm, very similar to the size of the early-spawning kokanee observed in the North Fork Payette River in 1987.

On November 4, 1986 and as yet unreported, IDFG personnel set four experimental gill nets in Payette Lake overnight. The relative species composition is very similar to that from Payette Lake gill net catches obtained by Welsh (IDFG file data) in the fall seasons of 1981 and 1982 (Table 5). Although two-thirds of the species were game fish, squawfish and suckers constituted three-fourths of the total catch. Kokanee was the most numerous game fish, followed by rainbow trout. Less than l% of the catch was lake trout.

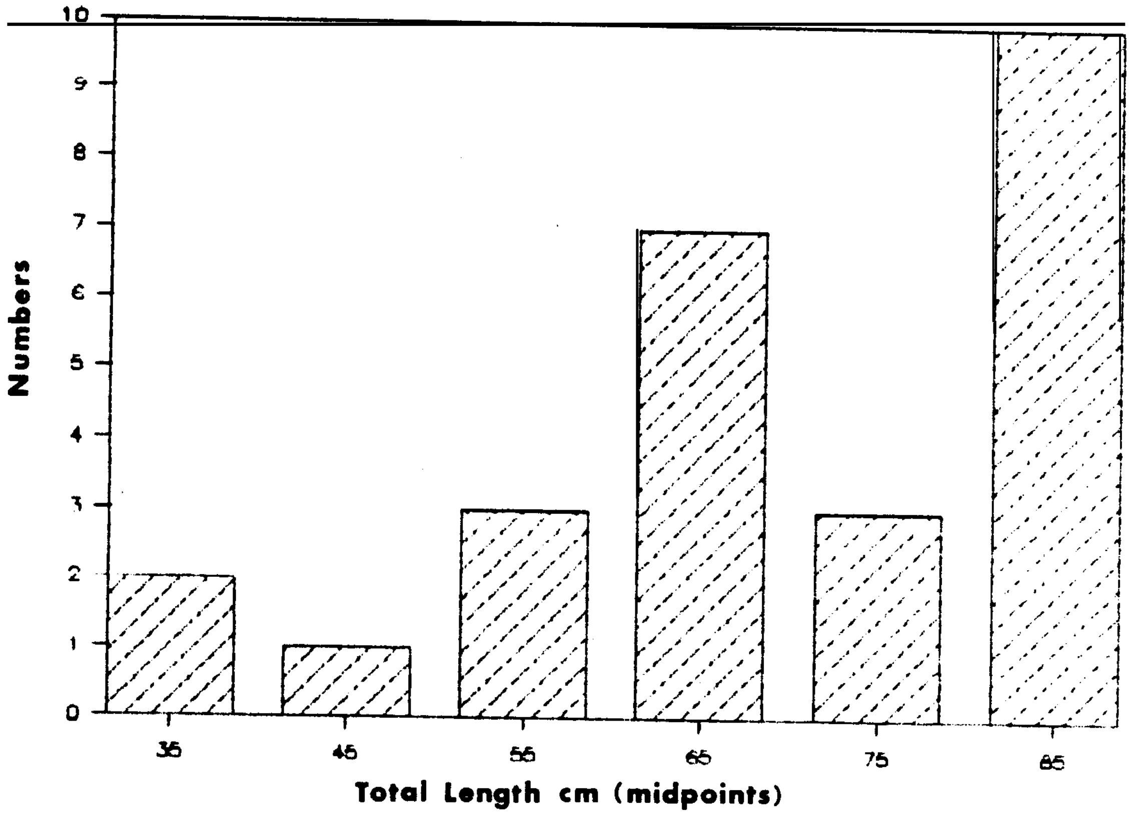

Figure 1. Length frequency distribution of rod and reel-caught lake trout from Payette Lake in 1986 and 1987.

Table 5. Relative species composition of fish caught with gill nets in Payette Lake in the 1981, 1982, and 1986 fall seasons.

Species	Percent of species composition	
	1981-1982	1986
Squawfish	45	35
Suckers	30	42
Kokanee	10	12
Rainbow trout (hatchery)	6	2
Whitefish	6	4
Rainbow trout (natural)	2	1
Perch	2	2
Lake trout	1	1
Shiners	0	2

Mean length of gill net-caught suckers and squawfish in Payette Lake in 1986 were 38 and 32 cm, respectively, compared to 30 and 26 cm for these species in Little Payette Lake. The extensive littoral area in Little Payette Lake may result in increased recruitment and stunting in these species or predation by lake trout in Payette Lake may reduce the numbers of small suckers and squawfish, resulting in better growth for those that remain.

Lost Valley Reservoir

From May through September 1987, 59,323 hours of fishing effort were expended at Lost Valley Reservoir to catch 25,017 rainbow trout at an average catch rate of 0.45 trout per hour (Table 6).

Table 6. Monthly estimates of fishing effort (F), fish per hour catch rate (C/F), and number of fish caught (C) from May through September 1987 at Lost Valley Reservoir.

Months	F ± 80% CLs	C/F ± 80% CLs	C ± 80% CLs
May	17,726 ± 49Z	0.52 ± 32Z	7,781 ± 43Z
June	16,851 ± 15	0.53 ± 65Z	8,424 ± 45Z
July	12,453 ± 34	0.36 ± 57Z	4,790 ± 39Z
August	8,810 ± 701	0.27 ± 37Z	2,204 ± 53Z
September	3,483	0.54	1,818
Totals	59,323		25,017
Average		0.45[a]	

[a]Weighted by monthly effort.

In 1986, rainbow trout fry, fingerlings, catchables, and large catchables were stocked into Lost Valley Reservoir (Table 7). Additionally, 209 cutthroat trout broodstock culls averaging 35.7-cm long were stocked. The three strains of fingerling and fry were individually grit marked for later identification in the creel, but the mark was not observable even with the aid of a black light. Thus, we were unable to evaluate the performance of each of these strains. Likewise, we were unable to differentiate between the large catchables of unspecified origin and the Mt. Lassen catchables. We were, however, able to distinguish between the juveniles and catchables by the fin erosions on the catchables and their larger size.

Table 7. Rainbow trout stocked in Lost Valley Reservoir in 1986 following the rotenone rehabilitation of October, 1985.

Dates	Strain	Number	Mean length
Catchable size			
May 1	unspecified	9,800	33.9 cm
May 14	Mt. Lassen	14,850	22.7 cm
Juveniles			
July 7	Mt. Shasta	29,670	10.1 cm
July 7	McConaughy	37,500	6.8 cm
July 7	Eagle Lake	25,500	6.5 cm

Most of the sampled catch (93%) in April 1987 were held over catchables, and the average trout size in the sample was 36.5 cm (Figure 2). As the summer season progressed, rainbow from the 1986 juvenile plants became more prevalent in the catch and the catchables less prevalent. Average trout size in the catch decreased to 32.4 cm in June, then increased up to 34.9 cm by September as the 1986 juveniles continued to grow. These changes in trout strain composition could also be seen in the standard deviation of the sampled lengths. It was largest in May when the fingerlings planted in 1986 had just begun to enter the fishery and smallest in September when the fingerlings from 1986 had grown and the catchables had mostly disappeared from the catch.

There is ample road access around most of the reservoir, and the slope of much of the shoreline is conducive to bank fishing. Additionally, there are two boat launching sites, and the majority of the fishing takes place from boats and float tubes. The percentage of anglers using boats, however, decreases in late summer as the submerged vegetation makes trolling difficult and the water level recedes below the cement launching ramps (Table 8).

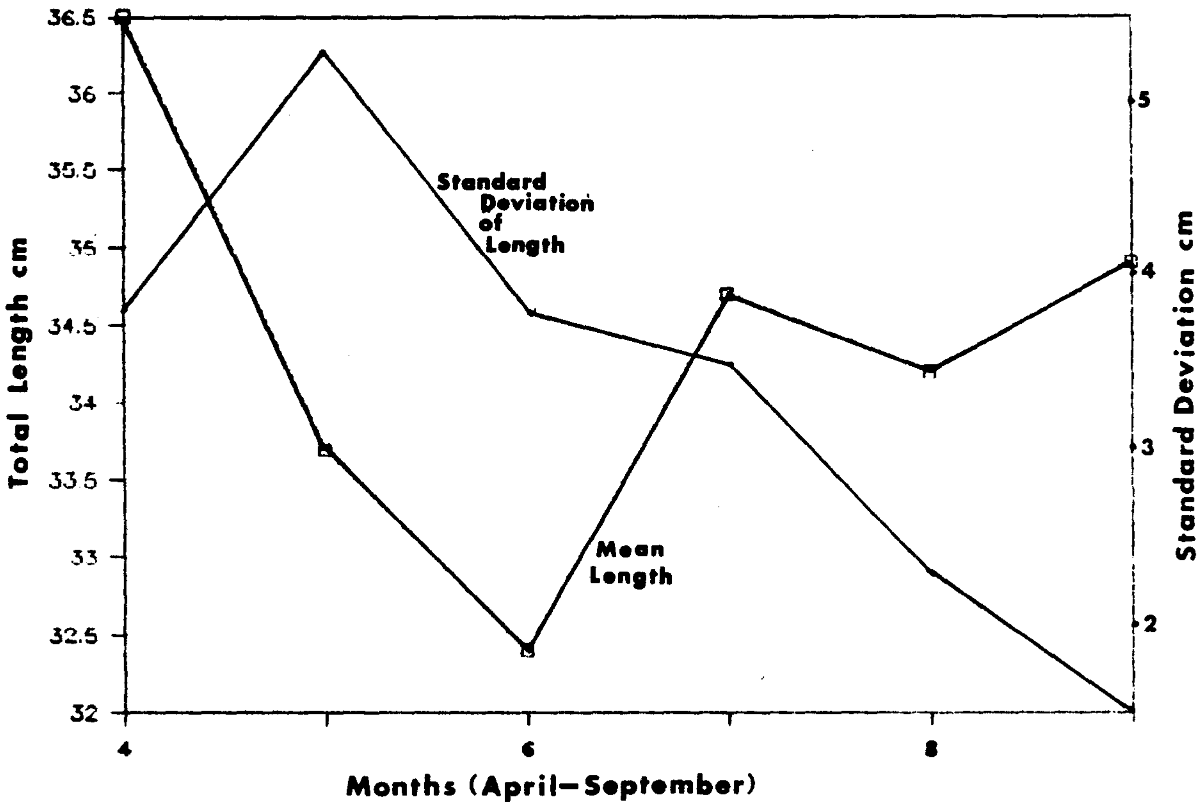

Figure 2. Mean monthly lengths and standard deviations for rainbow trout harvested at Lost Valley Reservoir from April to September, 1987.

Table 8. Percent of anglers counted during the months of May through September 1987 that fished from a boat, from the bank, or from a float tube at Lost Valley Reservoir.

Month	Percent of anglers fishing from			N
	Boat	Bank	Tube	
May	58%	34%	8%	160
June	68%	21%	11%	250
July	62%	34%	4%	143
August	44%	34%	22%	113
September	10%	53%	37%	19

An observation frequently noted was that the catchables, which appeared in excellent condition, fed heavily on the abundant small snails in the reservoir. The 1986 juveniles, even when they had grown to large size, appeared not to use this food source. Additionally noted was the rare but present occurrence of yellow perch in the catch.

Warm Lake

The four gill nets set overnight in Warm Lake on July 1 captured 56 fish, of which 96Z were game fish. However, the majority (54%) of these were whitefish, which are generally not part of the angler catch. The remaining species in decreasing order of abundance were kokanee (27%), rainbow trout (12%), brook trout (4%), and suckers (4%). Of the species most commonly caught by anglers, kokanee were the most abundant in gill nets followed by rainbow trout and brook trout. Most of the kokanee and whitefish were captured in the net on the lake bottom at a depth of 12 m in the west end of the lake. Rainbow and brook trout were captured in a net at the surface in the shallow, southern part of the lake. The relative species abundance can be compared to a composite gill net catch (n=158) from the 1960s. The earlier sample had a much larger percentage of suckers and a much smaller percentage of whitefish than did the 1987 sample. Additionally, the abundance of kokanee relative to that of rainbow and brook trout was much less than in the 1987 sample (Table 9).

Table 9. Relative species composition in gill net catches in the 1960s (composite sample) and on July 1. 1987 at Warm Lake.

	Percentages						
Years	Rainbow trout	Brook trou	Bull trout	Kokanee	White-fish	Suckers	Shiners
1960s	15	14	6	4	6	54	4
1987	12	4	-	27	54	4	-

Mean lengths of each species captured in gill nets were 32.6 cm for whitefish, 22.4 cm for kokanee, 24.5 cm for brook trout, 25.0 cm for rainbow trout, and 24.0 cm for suckers. Comparative lengths from a gill net catch on May 30, 1964 for kokanee, brook trout, and rainbow trout are 17.3 cm, 24.8 cm, and 25.6 cm, respectively. The only change is that the kokanee may be larger now, but since the 1987 sample was a month later in the summer, the lengths may not be directly comparable. Additionally, Monty Richards (1961) wrote that kokanee averaged 22 cm in May and spawned in October at 23 cm, a growth of only 1 cm through the summer. The true mean length of kokanee in May in the early 1960s was probably between the values of 17 and 22 cm estimated above.

Water temperature at 2000 hours on July 1, 1987 was 20.5°C at the surface and 4.0°C at a depth of 16 m and deeper. The thermocline ranged from 3 m to 8 m of depth where temperature decreased from 18.5°C to 10°C. Dissolved oxygen was above 7 mg/l from the surface down to 11 m, then slowly decreased to 4 mg/1 at 18 m.

Total nitrates, total dissolved solids (TDS), total phosphorous, and chlorophyll A were measured at four locations (Table 10). TDS is considered one of the more reliable indicators of relative productivity (Northcote and Larkin 1956; Ryder 1965; Ryder et al. 1974). TDS at Warm Lake averaged 41 mg/1, a low value when compared with productive waters such as Clark Canyon Reservoir in western Montana at 345 mg/1 (Nelson 1975), but is more productive than Idaho Batholith waters such as Little Payette Lake at 22 mg/1. Carlson (1977) presented a method for indexing the trophic status of lakes from a scale of 1 to 100, with 100 being the most productive. The method can use either Secchi disc values, chlorophyll A, total phosphorous, or a combination of all three parameters to calculate the trophic status. From the available data, chlorophyll A appears to be the most useful. Mike Falter (personal communication) said the sample collected at the lake outlet would be most representative and based on that value, the trophic status index of Warm Lake is 41 (compared to trophic status values of 35 at Little Payette Lake and 44 at Lost Valley Reservoir).

Table 10. Productivity indices measured at Warm Lake on August 12, 1987. Samples are composites from different depths. Depth listed is mean depth of the composite.

Location	Total nitrates mg/l	Total phosphorous mg/1	Total dissolved solids mg/1	Chlorophyll A mg/1	Depth (m)
Inlet	0.006	<0.05	41	2.40	2.0
Midlake					
Epilimnion	0.008	"	41	1.60	15.0
Hypolimnion	0.046	"	39	3.62	5.0
Outlet	0.042	"	43	3.03	2.0
Means	0.026	<0.05	41	2.66	

Oxbow Reservoir

The proportional stock density (PSD) of smallmouth bass at Oxbow Reservoir varied with the sampling method (Table 11), ranging from 0.6% to 10.2% and averaged 3.9%. Although PSDs are generally reserved for electrofishing data, Anderson (1980) stated that preliminary information for largemouth bass indicates a general 1:1 relationship between electrofishing PSD in the spring and those based on angler catch over the fishing season. All three values are extremely low relative to the desirable PSD range of 40-602. Low PSDs result from large numbers of stock size (>18 cm) relative to quality size (>28 cm) smallmouth bass.

Table 11. Proportional stock densities of smallmouth bass, sample sizes, and sampling periods in 1987 at Oxbow Reservoir.

Sample method	Sampling dates	PSD	Sample size
IDFG Rod & Reel	5/14	10.2	60
Electrofishing	5/14	0.6	162
Outfitter Rod & Reel	5/26-7/21	0.8	786
Mean		3.9	

This is illustrated by length frequency distributions for each of these samples (Figures 3 and 4) in that almost all the bass are less than 28 cm (11 inches) long. 'Electrofishing and the outfitter's catch through midsummer sampled small fish, 14 to 16 cm, that are probably age 1 bass, while the May 14 rod and reel sample did not.

Mean relative weight (Wr), based on electrofishing data is 87% for smallmouth bass between 14 and 28 cm long, considerably less than the 100 + 5% generally associated with balanced bass populations¯. W_r is the measured weight divided by a standard weight (Wege and Anderson 1978) and expressed as a percentage. Smallmouth bass weights were generally less than standard weight up through 28 cm (Figure 5). The Wr for Oxbow Reservoir bass was lowest in smaller bass and progressively increased with increased length. Data from rod and reel sampling for fish larger than 28 cm were added to electrofishing data to produce Figure 6. The regression of relative weight on length is:

$$Wr \quad 65.45 + 1.02\ L$$
$$r = 0.87$$

Where,

W_r is as described above, and
L is length in centimeters.

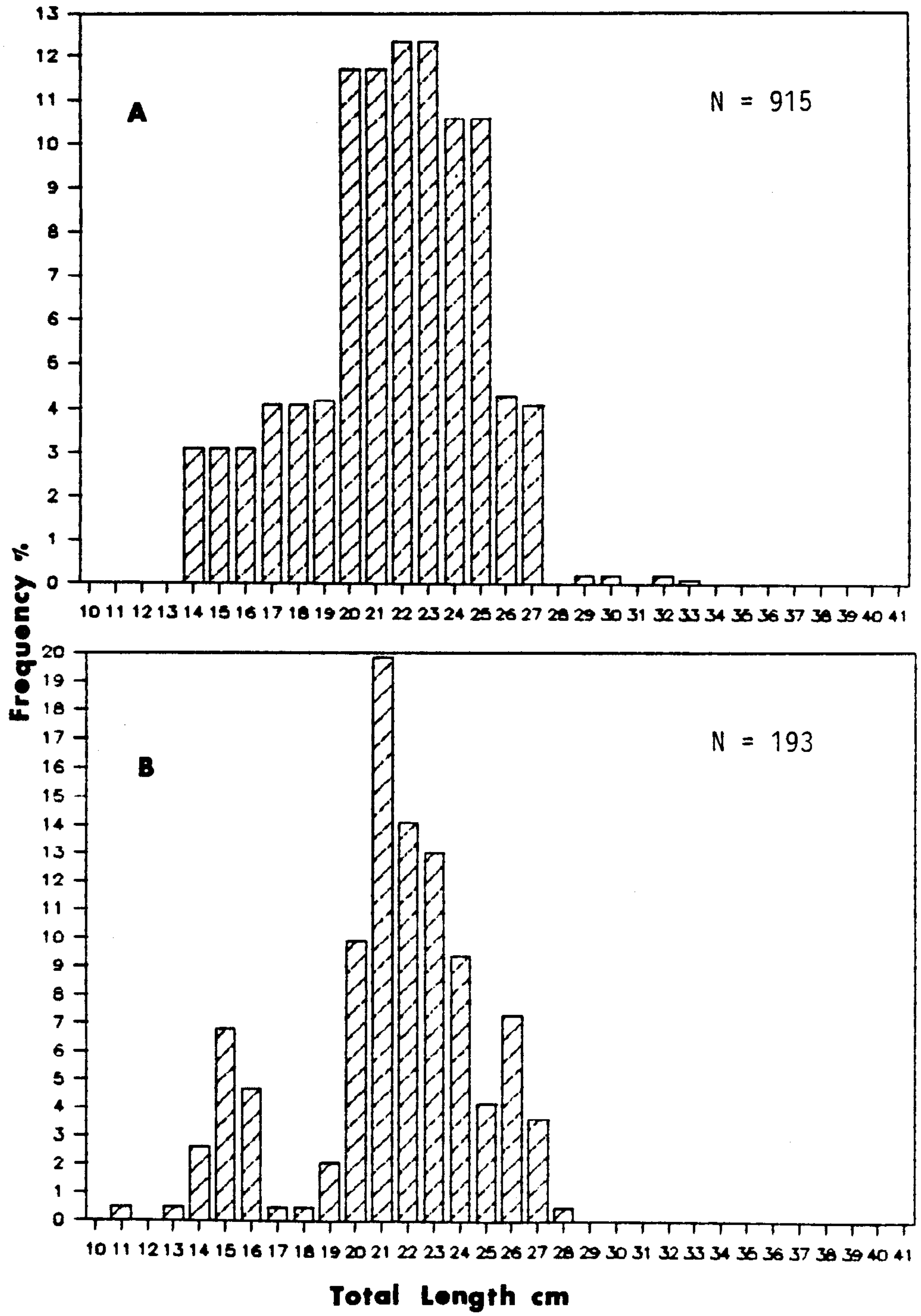

Figure 3. Length frequency distributions of smallmouth bass sampled from (A) angler catches and (B) by electrofishing at Oxbow Reservoir in 1987.

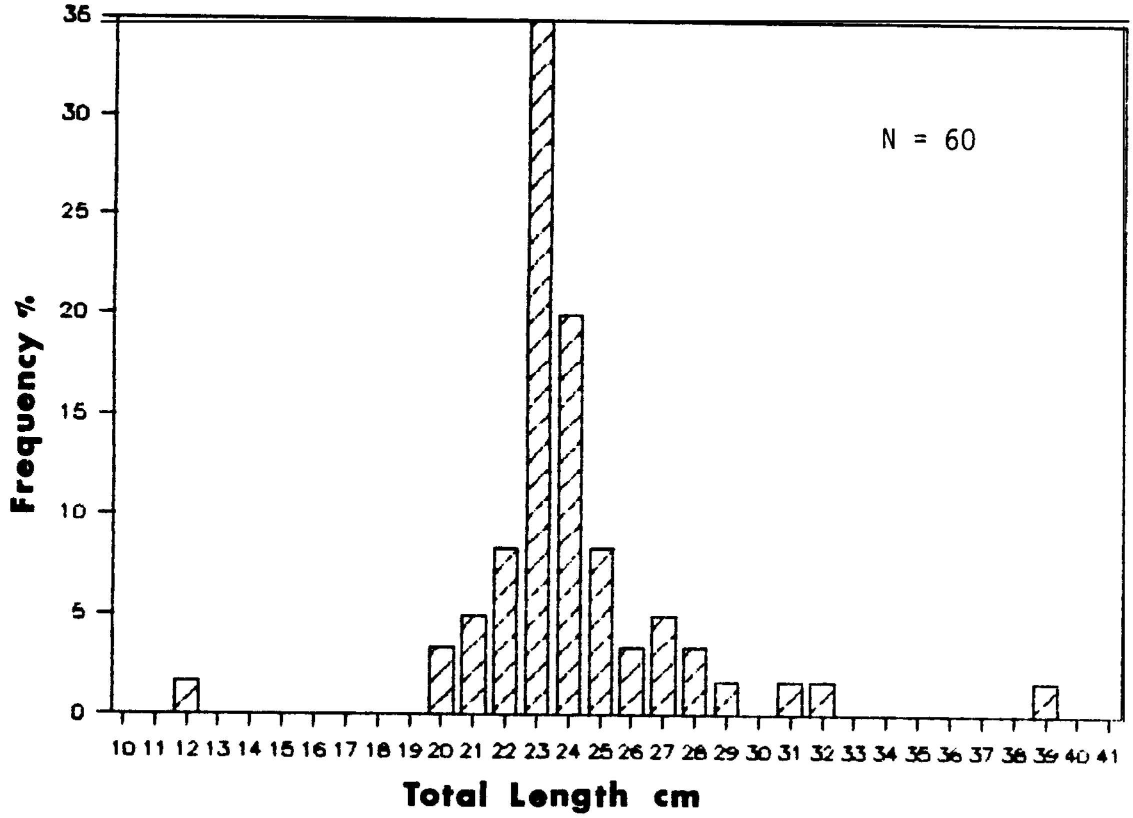

Figure 4. Length frequency distribution of smallmouth bass sampled by rod and reel at Oxbow Reservoir, 1987.

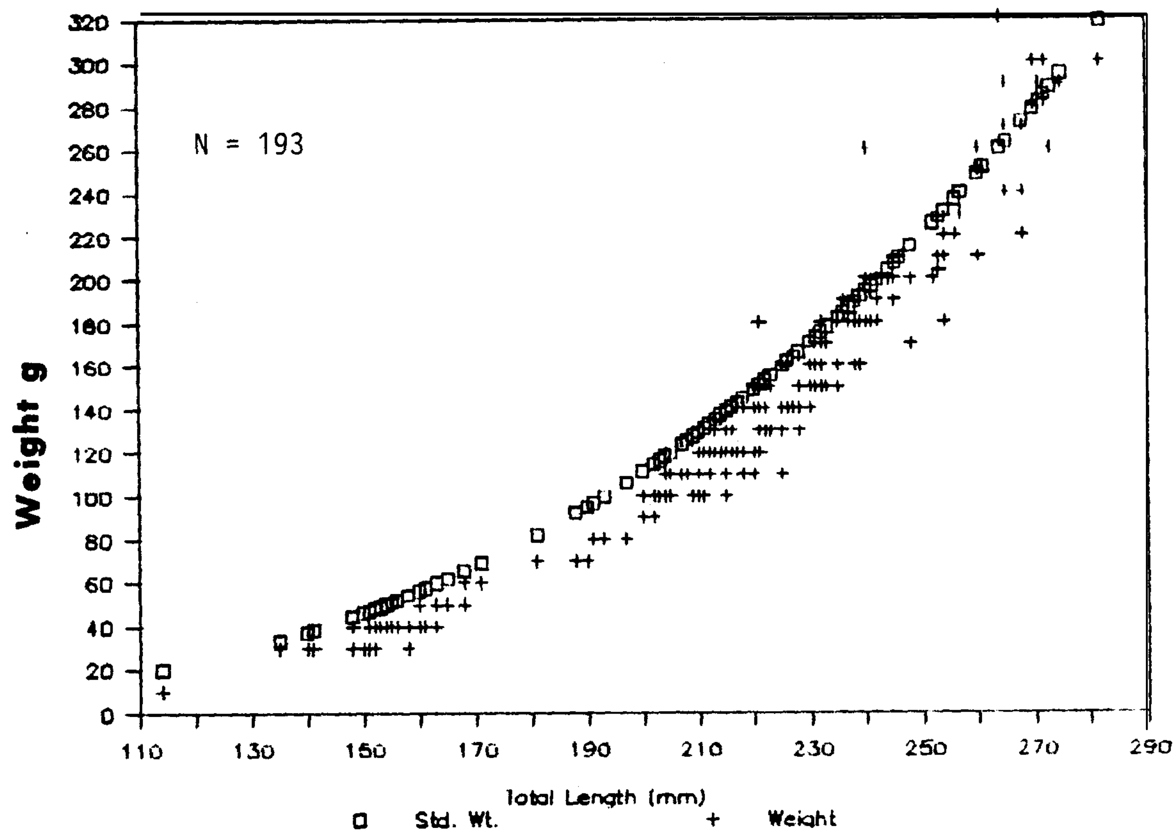

Figure 5. Standard weights compared to weights of smallmouth bass sampled by electrofishing at Oxbow Reservoir, May 14, 1987.

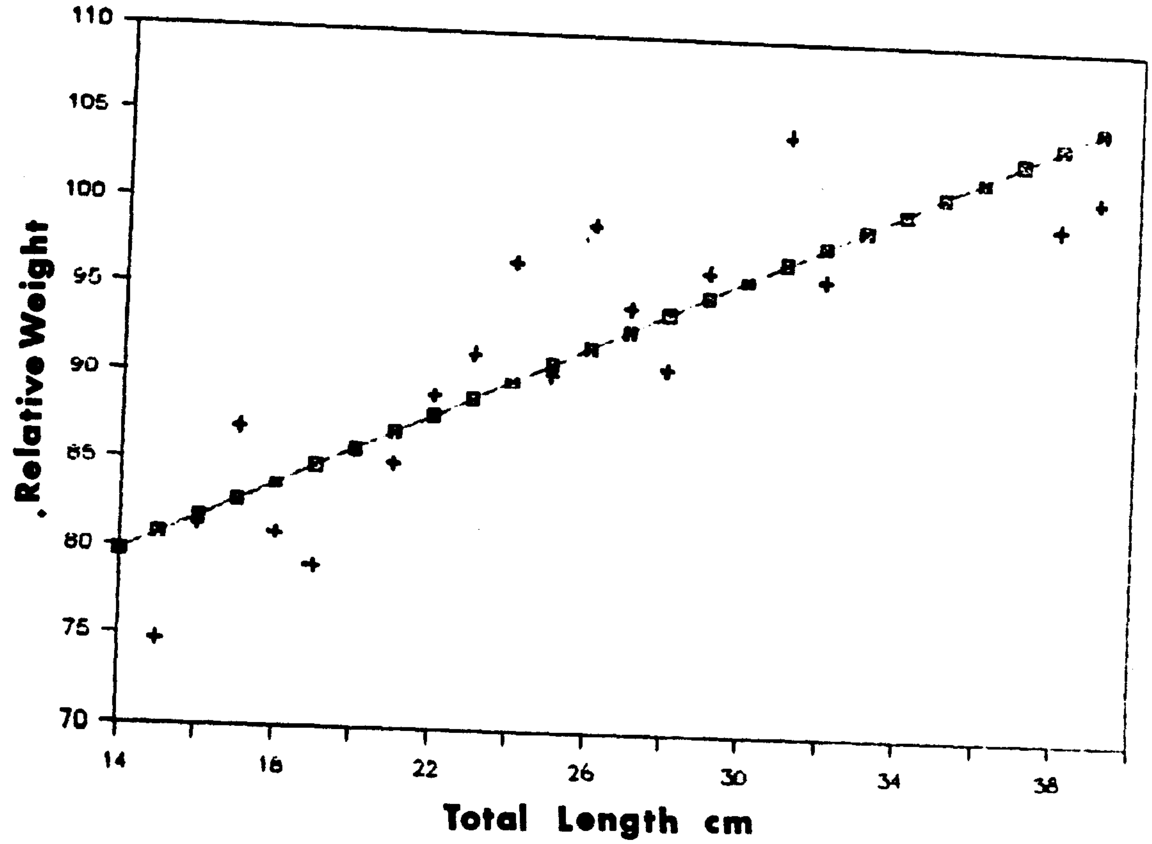

Figure 6. Mean relative weights by centimeter interval and the regression of relative weight on total length for smallmouth bass sampled at Oxbow Reservoir on May 14, 1987.

This is the first year that a large sample of bass was collected; thus, it can not be compared to past samples for size distribution and relative weight. The rapid reduction in bass numbers at 28 cm, at least 2 cm less than the minimum size limit, indicates that the limit imposed in 1986 had not yet affected the size structure of the bass population, or that anglers began to harvest bass when they were within 2 cm of the legal size.

Hells Canyon Reservoir

Proportional stock density estimates for smallmouth bass were higher at Hells Canyon Reservoir than at Oxbow Reservoir (Table 12). Data from bass club members who generally target larger bass did not produce a larger PSD value than for the other sampling methods.

Table 12. Proportional stock densities, sample sizes, and sampling dates at Hells Canyon Reservoir in 1987.

Sampling method	PSD	Sample size	Sampling dates
IDFG rod & reel	19.7	66	5/11
Electrofishing	30.5	118	5/11
Bass Club angling	14.8	216	5/18-5/21
Mean	21.7		

The increased PSDs relative to those at Oxbow Reservoir can be seen in the three length frequency distributions for Hells Canyon Reservoir (Figures 7 and 8). There are many more quality size bass in the samples from Hells Canyon Reservoir than from Oxbow Reservoir.

Horsethief Reservoir

During the opening weekend of trout season at Horsethief Reservoir, May 23 and 24, 1987, angler use was 6,452 fishing hours. This is 80% of the 1974 through 1987 average, excluding 1981 when only catch rate was estimated. Total harvest was 4,502 trout, which was 91% of the average since 1974 (Table 13). As usual, most of the use (60Z) and harvest (77%) occurred on the opening day. The average length of trout harvested during the census period was 305 mm, compared to 294 mm in 1986, and 277 mm in 1985.

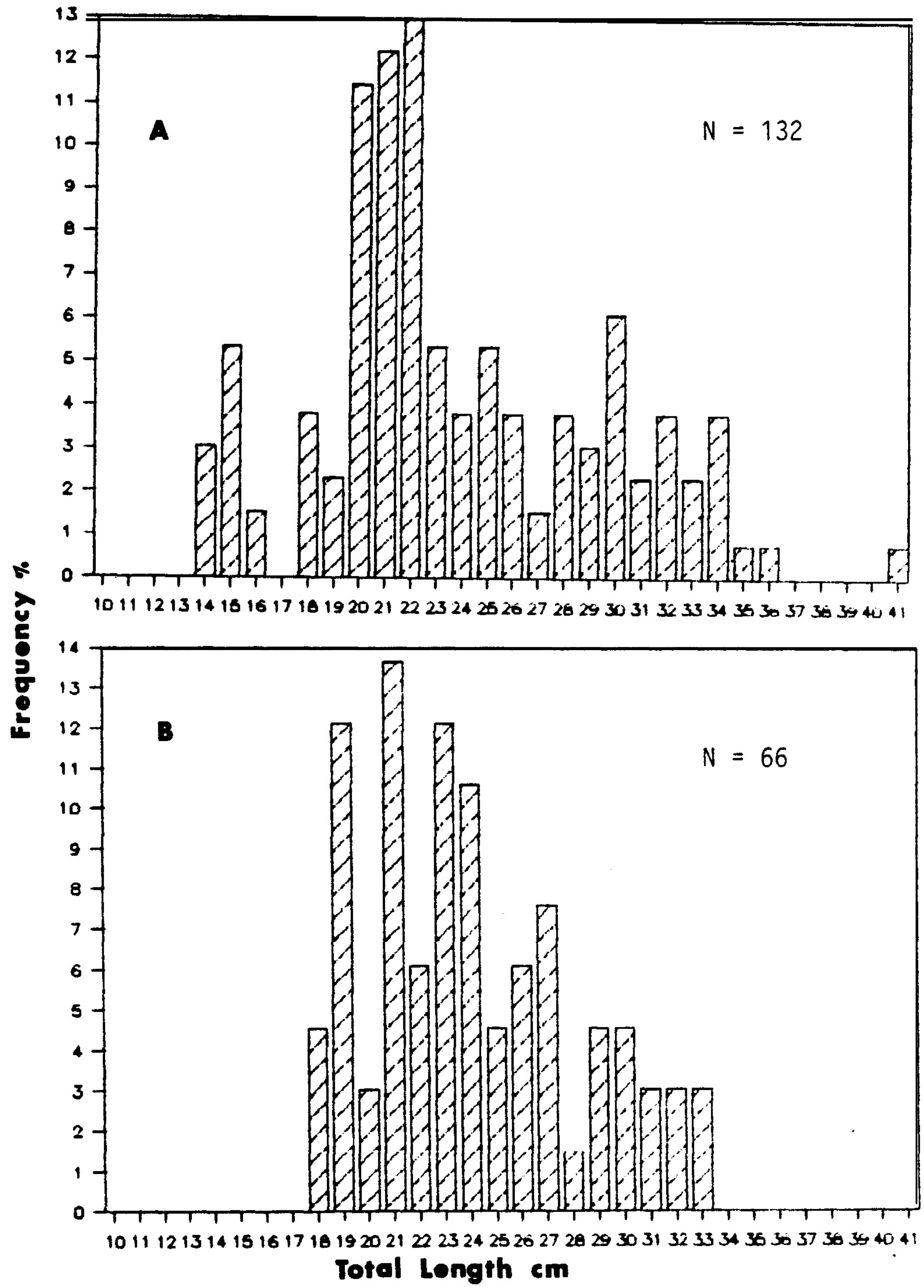

Figure 7. Length frequency distributions of smallmouth bass sampled from Hells Canyon Reservoir on May 11, 1987 by (A) electrofishing and (B) rod and reel.

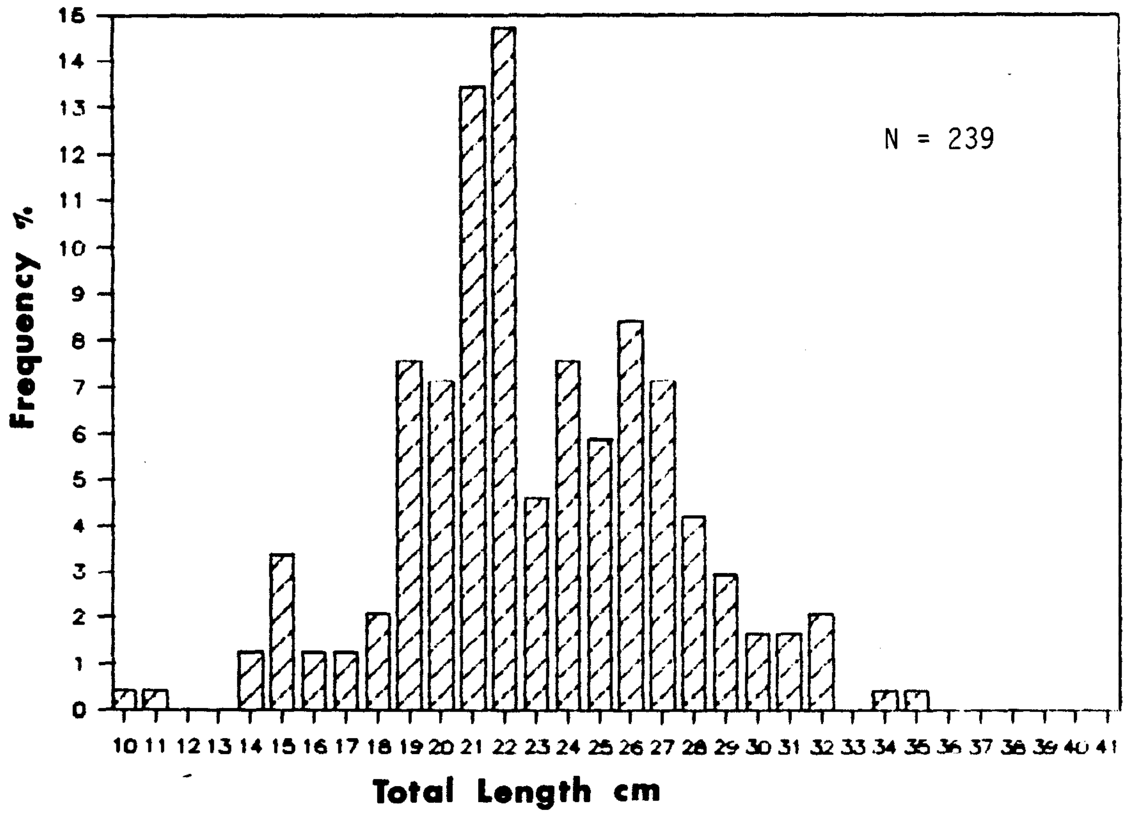

Figure 8. Length frequency distribution of angler-caught smallmouth bass at Hells Canyon Reservoir, May 18-21, 1987.

Table 13. Opening weekend angler use and harvest data for Horsethief Reservoir, 1974-1987.

Year	Fishing hours	Brook trout	Cutthroat and hybrids	Rainbow	Total trout	Trout per hour			
						Boat	Bank	Tube	All
1974	12,134	0	0	7,444	7,444	--	--	--	0.6
1975	7,786	8	0	3,137	3,145	--	--	--	0.4
1976	12,345	224	149	9,944	10,34	--	--	--	0.8
1977	7,443	51	148	4,620	4,744	--	--	--	0.6
1978	8,847	18	27	3,040	3,067	--	--	--	0.3
1979	5,876	197	329	1,909	2,435	0.21	0.48	1.53	0.4
1980	3,167	12	0	6,044	6,044	2.60	0.98	5.13	1.9
1981	362[a]	--	--	376[a]	--	--	--	--	1.0
1982	8,688	167	142	4,759	5,058	0.77	0.52	1.17	0.6
1983	4,685	89	25	2,153	2,267	0.53	0.52	0.31	0.4
1984	3,477	1	0	1,379	1,380	0.87	0.12	0.68	0.4
1985	6,205	0	0	8,982	8,982	1.70	1.33	1.57	1.4
1986	7,940	1	0	6,271	6,272	0.90	0.78	0.50	0.7
1987	6,452	13	0	4,489	4,589	0.95	0.53	1.03	0.6
Means	7,311				5,059				0.7

[a]Only catch rate from a sample of anglers was calculated in 1981.

DISCUSSION

The decision to eradicate the fish populations in Little Payette Lake and start over appears to have been sound, based on the postmortality examination which revealed a stunted fish community, mainly squawfish, suckers, whitefish, and kokanee. Very few trout were seen, and these were hatchery catchables which showed no growth since they were planted in 1986. The IDFG had tried introduction of various predacious salmonids in recent years, including fall chinook salmon, wild Kamloops, and Bear Lake cutthroat trout. None of these were seen in the postmortality windrows and it appeared that they had no effects on the stunted populations mentioned above.

Installation of the migration barrier below LPL, if effective, will change the posttreatment scenario considerably from that which occurred after the 1971 treatment. Lake Fork Creek is a natural migration corridor for fish moving upstream from productive Cascade Reservoir, and LPL is in the range of the reservoir's spawning squawfish and suckers. With this source of nongame fish removed, the newly stocked trout will be better able to achieve their growth potential and continue to do so far into the future. Rainbow trout do not compete well with other species in lakes, and forage fish are not necessary for large fish to develop. In fact, forage fish more often prove to be a competitor (Borgeson 1966).

The chemical rehabilitation of LPL was expensive, costing $36,500 for powder and $1,200 for liquid rotenone. Chemical costs would have been almost double if only liquid rotenone was used. Application of powder was possible because the State of Utah loaned the IDFG two rotenone distribution barges and experienced operators. This was an opportunity for several IDFG biologists to observe this method and consider whether the IDFG should invest in barge equipment for future use. The State of Washington Department of Game also offered to demonstrate their method of applying powder rotenone, towing 23-kg bags behind boats. According to their biologist, Steve Jackson, LPL could have been treated in a single day without the use of barges and a cement truck. Rather, 15 to 20 small boats towing bags would have been employed. Applying powdered, rather than liquified rotenone, does appear to be an evolutionary reversal (Gebhards 1988). However, when treating large bodies of water, the economic savings has a strong appeal and may be the deciding factor in whether or not the rehabilitation project will occur.

The IDFG conducted creel surveys on LPL in 1971 and 1972 before and after chemical rehabilitation to compare catch statistics (Table 14). Catch rates for game fish changed little, from 0.9 to 1.0 fish per hour. However, catch rate for trout alone changed from 0.37 to 1.0 fish per hour. Effort did not change as much as might be expected. In fact, almost all the effort in 1972 occurred in the last month of the survey, after word had gotten out that fishing was very good. The effect of the rehabilitation on fishing effort may have been determined better by surveying in 1973 rather than 1972.

Table 14. Fishing effort, catch, and catch rate for game fish at Little Payette Lake in 1971 and 1972, before and after chemical rehabilitation the fishery.

Years	Effort (hours)	Catch (game fish)	Catch rate
1971	867	321 rainbow trout 452 kokanee	0.89
1972	2,327	2,323 rainbow trout	1.00

The IDFG is predicting a marked increase in fishing effort at LPL after the 1987 fishery rehabilitation. The media has frequently mentioned the LPL project and expectations are high. Additionally, the change from standard to trophy trout regulations has stimulated additional interest.

In 1985, Sorg et al. (1985) estimated that the net economic value (travel cost method) of Idaho's coldwater fisheries in west-central Idaho was $34.44 per angler trip, and a trip averaged 9.11 hours of fishing. At this rate, the LPL's fishery in 1987 would have a net economic value of $3,565.

The total cost of chemically treating LPL for materials, labor, and miscellaneous expenses is about $45,000. An increase of 10,970 hours of fishing, which should occur within the first year after treatment, would balance the cost of lake rehabilitation. This is not an unreasonable amount of increased effort to expect.

For example, Lost Valley Reservoir, a 256-hectare impoundment approximately 30 km from LPL, was chemically rehabilitated in 1985 when it was determined that stunted yellow perch had reduced fishing effort to an insignificant level. A summer creel survey (May through September) in 1987 estimated fishing effort in excess of 59,000 hours.

Table 15, taken from Cochnauer (1982), demonstrates Payette Lake's low productivity relative to other large, natural lakes in northern Idaho. Payette Lake has 63% of the summer zooplankton biomass, 36% of the specific conductance, and 33% of the morphoedaphic index (MEI) value of the next lowest lake. Additionally, it is 12% more transparent than the lake with the next lowest MEI.

Table 15. Comparison of zooplankton biomass and indices of productivity in six Idaho lakes (Cochnauer 1982).

Lake	Summer mean zooplankton biomass (mg/m)	Conductance (umhos)	Summer mean transparency (m)	MEI
Spirit	46.1	240	3.9	10.0
Pend Oreille	38.7	180	6.3	0.6
Coeur d'Alene	36.8	80	5.1	1.4
Priest	27.7	50	8.0	0.7
Upper Priest	25.5	100	5.9	4.1
Payette	16.1	18	9.0	0.2

In a limnological survey of Payette Lake, Falter (1984) rated Payette Lake as mesotrophic (moderately productive), but stated that it has a higher nutrient absorption capacity than indicated by standard predictive formulations due probably to the lake's high elevation. He also determined that 88% of the total phosphorous loading to the lake arrives via the North Fork Payette River, or nonimpacted tributary streams. Thus, the sewer line installed for lakeside residential use in the early 1980s would not result in a significant reduction in nutrient delivery to the lake.

Falter and Mitchell (1981) state that the phytoplankton of Payette Lake is dominated by diatoms, typical of low productivity waters, and that chlorophyll A concentrations are "extremely low." Their recorded alkalinity values, ranging from 6 to 15 mg/l, also indicate low production potential. On the positive side, Payette lake has a very irregular shoreline (shoreline development ratio of 2.28), which can enhance biological production.

Welsh (1973) conducted summer creel surveys on Payette Lake in 1971 and 1972 and estimated kokanee harvests of 7,217 and 6,811, respectively. Estimated kokanee harvest during summer 1987 was 424 fish, only 6% of the earlier values. There are at least three possible reasons for the decline in kokanee harvest:

1. Kokanee may be recruitment limited in Payette Lake, and the stocking program which occurred from 1962 through 1976 (Table 16) may have provided a significant increase in adult kokanee over that provided by natural production.

2. Almost all early-spawning kokanee (and these may be the majority of the kokanee in Payette Lake) spawn in the approximately 5 km reach of the North Fork Payette River immediately below the mouth of Fisher Creek. Reed Gillespie, long-time McCall resident and angler (personal communication), informed the authors that a large landslide occurred on the north side of the NFPR not far downriver from the mouth of Fisher Creek 12 to 15 years ago, transporting a large amount of sediment into the NFPR. IDFG and Payette National Forest biologists examined the spawning substrate in the NFPR in the summer of 1987 and visually observed that the substrate was highly impacted. In September 1987, it appeared that spawning kokanee were unable to move much of the impacted gravel they were spawning over, and it is probable that egg survival would be very low.

3. Although lake trout were present in Payette Lake in 1971 and 1972, their numbers and average size were probably smaller than they are now. However, stocking of lake trout was begun in 1955, and they had been stocked in 10 of the years between then and 1971. Twelve more annual plants of lake trout have taken place since then, and larger lake trout are reported now (up to 89 cm) than in 1971 (76 cm).

Lake trout prey on the kokanee population. In combination with reduced recruitment as suggested above, this may significantly impact kokanee population numbers. The relatively large average size of kokanee spawners (30 to 31 cm) in such a sterile lake indicates that there are fewer kokanee in the lake than the lake could support if recruitment to harvestable size was improved.

The last year that kokanee were stocked in Payette Lake was 1976. Bowler sampled the kokanee population in 1980, a year after most of this group of fish should have spawned and died. Nevertheless, his samples indicate that spawners in the North Fork Payette River were smaller (males 27.5 cm and females 28.7 cm) than those seen in 1987 (31.3 and 30.0 cm, respectively). Additionally, Bowler estimated the kokanee density to be near 100/hectare, of which 10Z were age 3+, the age at which most would recruit to the fishery. Since the lake has 1,958 surface hectares, there would have been an estimated 9,790 age 3+ kokanee in the lake. Bowler described the Payette Lake kokanee population as "stable, with adequate recruitment to support the present densities." Age composition was 48% age 0+, 36% age 1+, 8% age 2+, and 10% age 3+. Biomass of kokanee was estimated at 1.0 kg/hectare.

During the 10 years that kokanee were stocked in Payette Lake between 1962 and 1976 (Table 16), the average annual release was near 144,000, or 74/hectare. The IDFG plans to stock kokanee fry at 550/hectare in Pend Orielle to replace a nearly complete loss of age 0 kokanee due to *Mysis* competition. Pend Oreille Lake has about 2.4 times the summer zooplankton density of Payette Lake, and an assumption could be made that Payette Lake could thus sustain about 229 age 0 kokanee/hectare. However, since Bowler in 1980 estimated that there were 100 kokanee/hectare in Payette Lake and 48% of these were age 0, enhancement of age 0 kokanee to a desirable density would require only 181/hectare, or 354,380 age 0 kokanee annually.

Table 16. Numbers of kokanee, lake trout, and catchable size rainbow trout stocked into Payette lake from 1955 to 1987.

Year	Species stocked		
	Lake trout	Kokanee	Rainbow trout
1955	9,550	0	?
1959	11,760	0	?
1960	8,025	0	?
1961	8,820	0	?
1962	10,060	49,500	?
1963	34,400	26,000	?
1964	0	0	?
1965	9,600	350,000	?
1966	10,000	0	?
1967	15,178	80,000	?
1968	15,178	150,000	?
1969	12,750	151,900	?
1970	0	177,325	?
1971	10,800	228,435	21,660
1972	7,221	0	30,040
1973	37,904	0	?
1974	29,950	0	?
1975	29,184	138,000	21,360
1976	0	87,500	24,330
1977	0	0	13,280
1978	0	0	21,160
1979	32,136	0	14,690
1980	2,560	0	20,520
1981	78,077[a]	0	30,190
1982	84,700	0	20,760
1983	27,400	0	17,939
1984	50,184	0	20,000
1985	46,140	0	19,927
1986	0	0	24,851
1987	0	0	17,184

[a]Size of lake trout stocked has varied greatly; for example, fish stocked from 1979 to 1981 were fry near 340/kg, and 36,400 of those released in 1982 were much larger, at 18/kg. Welsh (IDFG file notes) stated that lake trout stocked in the earlier years were subcatchables 15 to 18 cm long.

In general, lake trout mature in their sixth or seventh year, although maturation may occur as early as four or five years, or as late as 13 years (McAfee 1966). Fifteen to 20-year-old lake trout are common in many lakes. Long-lived fish, up to 41 years, are reported from cold, northern lakes.

Lake trout are best suited to survive in cold, well-oxygenated lakes such as Payette Lake. Lake trout generally stay in water that is less than 13°C throughout the year and their preferred temperature is near 10°C (Scott and Crossman 1973). Unpublished IDFG data from 1973 (Figure 9) demonstrates that lake trout could find 10°C water temperature throughout the warmest summer months in Payette Lake. Additionally, dissolved oxygen is generally above 7 ppm from the lake surface down to a depth of 50 m in midsummer (Falter and Mitchell 1981).

Low temperature and low productivity probably result in relatively slow-growing lake trout in Payette Lake. For example, a 10-year-old lake trout in Payette Lake is near 84 cm long, whereas the same age lake trout from Priest Lake in the mid-1960s, prior to the decline of that lake's kokanee population, was 91 to 107 cm (Mallet 1966). However, lake trout growth in Payette Lake, where most of the trout's food is fish, would be expected to be better than in lakes where invertebrates are the main food source (McAfee 1966). Lake trout eat many species of fish, depending mainly on availability. Gill net catches in Payette Lake demonstrate that several of their preferred forage species, e.g., whitefish, suckers, cyprinids (squawfish and shiners), and perch are available. In California lakes, kokanee are considered to be infrequent food of lake trout, but planted trout are eaten readily at the time of release (McAfee 1966).

The 1987 estimate of lake trout harvest from Payette lake is 470 fish averaging 57 cm in length, probably weighing an average of 2 kg. This would be a harvest rate of 0.5 kg/hectare, which in Canadian lakes would be near the maximum sustainable yield for lake trout (McAfee 1966). Recent harvest estimates of lake trout in Priest Lake are closer to 1 kg/hectare for trout which are now feeding mainly on Mysis.

Lost Valley Reservoir received considerably more fishing effort than the larger Payette lakes surveyed. The better catch rates and larger average size of fish were no doubt important factors in this difference. Additionally, Lost Valley Reservoir is more conducive to bank fishing and has more extensive areas for lakeside tent and trailer camping than do the two Payette lakes.

The catchable size rainbow trout, stocked in Lost Valley Reservoir in 1986 appeared very scarce by midsummer 1987. Many were sexually mature and cruising the shoreline in April 1987. Many of these may have died after this season. Also, fishermen reported excellent fishing all during the summer and fall of 1986 and good ice fishing the following winter. A large percentage of these fish may have been harvested by midsummer of 1987.

The abundant shallow areas in the south and east ends of Warm Lake, the mid-level elevation, and the moderate level of productivity indices would indicate that Warm Lake should support a moderate fishery. The

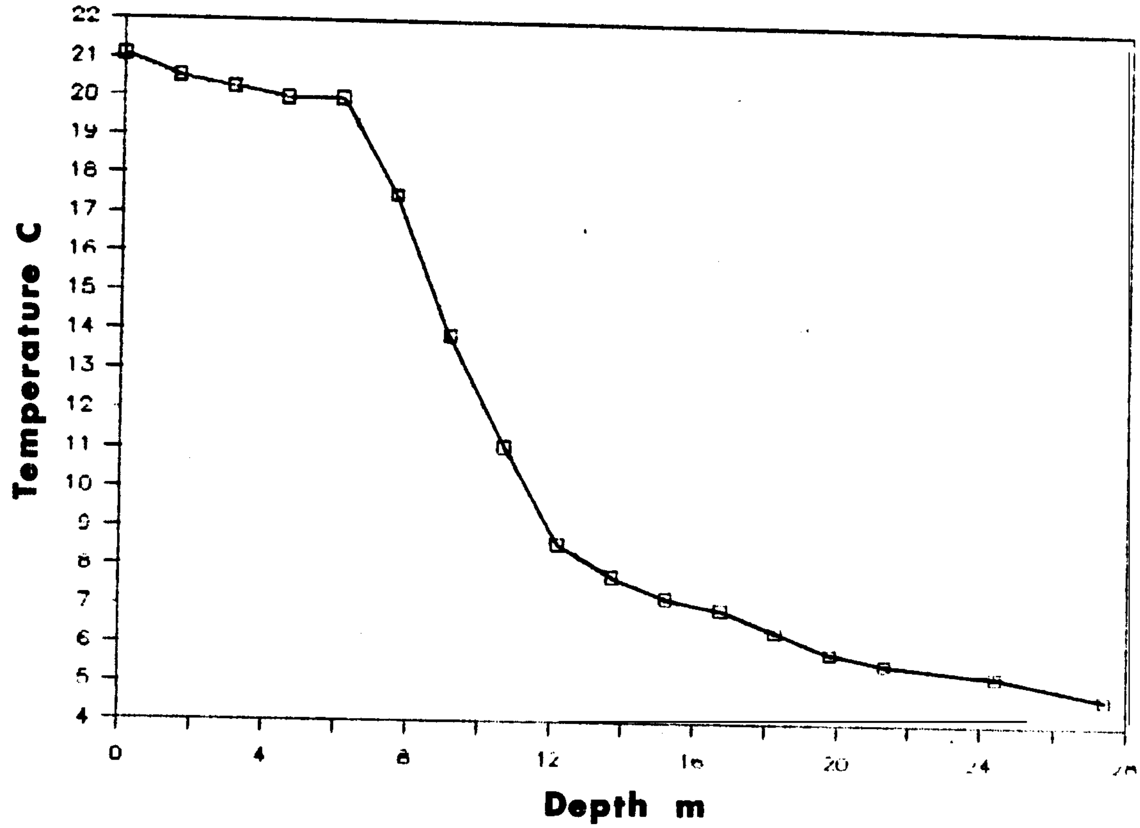

Figure 9. Water temperature profile at Payette Lake on August 2, 1976 (IDFG file data).

self-sustaining populations of intermediate size brook trout and kokanee do attest to this. However, the demand created by extensive lakeside cabins, resorts, and campgrounds merits the addition of the catchable rainbow trout, which increases the lake's harvest potential.

During the past 25 years, Warm Lake users and especially those operating tourist resorts at the lake have requested fisheries improvements, especially increases in numbers of catchable rainbow trout. In 1959, planting went from about 1,000 catchables per year to 2,400. In 1961, the number increased further to 5,000 annually. In 1977, the number increased considerably to 13,760. Annual stocking stayed between 14,900 and 9,600 through 1984 and since then has risen to 15,000 to 16,000 annually (Table 17).

Table 17. Stocking records at Warm Lake from 1975 to 1988.

		Rainbow trout catchables			Fingerling releases	
Year	Dates	Times stocked	Number stocked	Average size (cm)	Rainbow trout	Lake trout
1975	6/12-8/19	4	5,532	25		
1976	5/17-6/15	3	5,640	24	9,990 (15 cm)	
1977	5/09-8/02	7	13,760	22		
1978	5/15-7/28	5	14,871	21		
1979	5/21-6/13	2	12,390	25		
1980	5/21-6/02	2	10,860	24		
1981	7/27	1	16,500	23	48,96 (11 cm)	
						24,750 (8 cm)
1982	5/24-8/17	2	10,484	23		31,050 (7 cm)
1983	5/26-6/29	2	12,060	22		15,000 (17 cm)
1984	6/07	1	9,600	23		
1985	6/17-7/02	2	15,220	23	65,71 (5 cm)	
1986	6/05-7/11	3	15,275[a]	22		
1987	5/05-8/06	3	16,255[a]	22		
1988	5/15-7/02	2	15,000[b]	25		

[a]752 Mt. Lassen strain (R4).
[b]Projected stocking plan.

Additionally, intermittent releases of large numbers of rainbow and lake trout fry and fingerlings have occurred. Tom Welsh initially requested lake trout for Warm Lake in 1966 to reduce kokanee density. Since 1975, lake trout were stocked in 1981, 1982, and 1983. Lake trout stocked in 1983, were near catchable size at 17 cm and would have been the most likely group to survive in abundance to become successful predators.

In 1960, Monty Richards described Warm Lake anglers as being either summer residents who generally preferred to fish for brook trout with flies or bait near the lily pads, or "transient" anglers who mainly trolled and caught kokanee and a few rainbow trout. Brook trout and kokanee reproduced naturally in the lake and at the outlet, and Richards recommended that increased spawning habitat should not be made available in inlet streams.

Additionally, Richards recommended (and it was implemented in 1963) that the annual plant of 90,000 kokanee fry be discontinued to see if kokanee would obtain a larger size. It was also determined that stocked rainbow trout did not survive the winter. Nevertheless, the most significant management change at Warm Lake since the late 1950s has been the steady increase in the number of hatchery catchable rainbow trout.

Bull trout, occasionally reaching a length of 50 cm but generally near 28 cm, were a significant part of the catch in the years that opening weekend creel surveys were conducted, 1967 to 1971. Bull trout may still be part of the Warm Lake catch even though it is often said that the migration barrier created by the Cabin Creek culverts ended the movement of bull trout into Warm Lake from the South Fork Salmon River. The installation of the culverts on Cabin Creek occurred in 1955 and should not affect the abundance of bull trout in Warm Lake in 1987 anymore than it did in the late 1960s.

Catch rate during the opening week surveys ranged from 0.5 to 1.0 fish/hour and the catch was split evenly between rainbow trout, kokanee, and brook trout. These data differ from an opening weekend survey done in 1960, where three times as many brook trout were caught as kokanee. Rainbow trout made up only 4% of the catch. The difference is probably due to the increased number of rainbow trout stocked and possibly to a partial switch from still fishing in the shallows for brook trout to trolling in the open water for kokanee and rainbow trout. A survey at the present time would likely find that an even larger part of the catch is rainbow trout.

Proportional stock density and relative weight data from Oxbow Reservoir indicate that there are too few quality size bass in the population and that the smaller stock size bass are in poorer condition than the larger ones. Quality size bass appear to be in good condition. Length frequency data show a marked reduction in bass as they reach 28 cm (11 inches) long. Proportional stock density is much better in Hells Canyon than Oxbow Reservoir, and the rapid decline in bass in the catch occurs at a slightly larger size in Hells Canyon than in Oxbow Reservoir.

Lukens (1985) calculated Wr for 5-cm groups of smallmouth bass in the Snake River downriver from Hells Canyon Dam and found rather consistent W_r in the 15 to 30-cm groups (Table 18), with a slight decrease in W_r as length increased. This contrasts with smallmouth bass W_r at Oxbow Reservoir, which increased from 80 to 95 through the same size range.

Table 18. Comparison of relative weights (W_r) for smallmouth bass in the Hells Canyon reach of the Snake River in 1985 and Oxbow Reservoir in 1987.

Length interval	Relative weight	Sample size
	Snake River below Hells Canyon Reservoir	
151-200 mm	97.7	110
201-250 mm	96.3	87
251-300 mm	93.9	85
	Oxbow Reservoir	
151-200 mm	80.6	31
201-250 mm	89.6	123
251-300 mm	95.1	25

Brownlee Reservoir, immediately upriver from Oxbow Reservoir, was studied intensively from 1983 to'1986 in response to reports of a declining smallmouth bass fishery (Rohrer 1984; Rohrer and Chandler 1985; Bennett and Dunsmoor 1986). Rohrer found that bass suffered a very high annual mortality rate, estimated at 73% in 1983 and 82% in 1984, and that a large part of the mortality was caused by angling. Bass growth rates were said to be good for northern bass populations, even though there appeared to be a decline in the crayfish forage base. Bennett and Dunsmoor trapped crayfish in Brownlee and Oxbow reservoirs and found relative densities of 0.009 and 0.204 crayfish per trap hour, respectively, i.e., crayfish were 22 times more abundant in Oxbow than Brownlee Reservoir. The available prey-to-predator ratio (AP/P) for bass in Brownlee Reservoir suggested a shortage of prey biomass during spring and summer periods. A large percentage of the bass food, however, was zooplankton and macroinvertebrates other than crayfish, items which would not be considered in the A/P ratio. Rohrer and Chandler recommended a 14-inch minimum size limit on bass, and a 12-inch minimum size limit was implemented in 1986. The effect of the size limit has yet to be determined on Brownlee, Oxbow, or Hells Canyon Reservoir.

JOB PERFORMANCE REPORT

State of: **Idaho**

Name: **REGIONAL FISHERY MANAGEMENT INVESTIGATIONS**

Project No.: **F-71-R-12**

Title: **McCall Subregion Rivers and Streams Investigations**

Job No.: **3(MC)-c**

Period Covered: **July 1, 1987 to June 30, 1988**

ABSTRACT

Summer water temperatures were monitored with "max-min" thermometers in the North Fork Payette River from Payette Lake to Banks, in the Little Salmon River from New Meadows to the top of the Little Salmon River canyon, 12 km north of New Meadows and in the Weiser River from Fruitvale to the mouth of Goodrich Creek, below the mouth of the Middle Fork Weiser River.

Summer temperatures were high, but probably not limiting for trout in the North Fork Payette River. Temperatures rose to 22-24.5°C from late July to early August at several sites, but minimums during these intervals, which probably occurred nightly, dropped to the mid to high teens.

High water temperatures in the Weiser River were the most critical. Maximum temperatures of 30 and 30.5°C were recorded near Fruitvale between the time intervals of July 14-28 and July 28-August 20. Low temperatures of 12.5 and 14°C were recorded during these time intervals, however, and the extent of the high temperatures is unknown. A thermograph set in the Weiser River below the mouth of the Middle Fork Weiser River (near Goodrich) from July 28 through August 11 revealed that temperature exceeded 27°C (maximum setting for the thermograph) for up to 7 hours daily in late July. Minimum daily temperatures were 18 to 21°C during this time interval. Literature on trout temperature tolerance indicates that trout would have to avoid water with a temperature regime as recorded in the Weiser River in late July 1987. Temperatures in the lower reaches of the West and Middle forks of the Weiser River were about 3°C less than in the main river.

Maximum water temperatures in the Little Salmon River were less than those in the Weiser River and more than those in the North Fork Payette River. A thermograph stationed at Kimberland Meadows (3 km north of New Meadows) from July 28 to August 8 recorded high daily temperatures of 26°C in late July, decreasing to 21°C by August 8. Daily minimums ranged from 14 to 19°C.

Most of the fish observed in the North Fork Payette River between Cascade Reservoir and Payette Lake during midsummer snorkeling were dace, shiners, and juvenile whitefish. Of 4,297 fish counted, only 11 were rainbow trout. Eight of these were hatchery catchables. Natural recruitment of yearling rainbow trout is very low. This may be attributed to the discharge operation at Payette Lake, which changed discharge from

1,100 cfs on June 14 to 33 cfs on June 15, 1986. Discharge was further reduced to 25 cfs on June 20 (Harenberg et al. 1987). Sediment washed into the river from a gravel washing operation near McCall, and domestic sewage and fish hatchery effluents may also contribute to the lack of salmonids in the river.

Catchable trout stocked in the North Fork Payette River were found to generally stay near where they were stocked. To increase the distribution of these trout, more stocking sites will be required. Providing a hatchery catchable trout fishery between Lake Fork and Cascade Reservoir is not practical due to lack of stocking and public access sites.

The IDFG stocked 188,000 fry and 45,068 fingerling brown trout in the North Fork Payette River between Payette Lake and Hartsell Bridge at five stocking locations and at five times between May 28 and November 2, 1987. The latter three fingerling release groups were individually marked with fin clips. Success of the introductions will be evaluated in 1988 and beyond.

Established snorkel monitoring transects were monitored at 14 main stem South Fork Salmon River (SFSR) sites, 5 sites in SFSR tributaries, and 7 sites in the Middle Fork Salmon River (MFSR).

Additionally, four new transects were snorkeled in Big Creek, tributary to the MFSR; and five new transects were snorkeled in the Secesh River and Lake Creek, tributaries of the SFSR.

No significant changes were observed in established transects. Wild chinook salmon densities in the Secesh River and Lake Creek were higher than in the hatchery-enhanced areas of the SFSR and were similar to the wild chinook densities in Monumental Creek. Cutthroat trout densities in the SFSR remained low compared to densities in Big Creek, where a healthy population of cutthroat trout occurs.

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INTRODUCTION

Summer water temperatures were monitored in several of the McCall Subregion's mid-elevation (850 m to 1,500 m) rivers which are managed for trout fisheries and sustained by hatchery-reared trout. Most of these rivers flow through highly developed river corridors. Most are paralleled by highways or railroads, drawn on heavily for irrigation, and are grazed by cattle or sheep in riparian zones. They are also affected by other land disturbing activities elsewhere in the drainage such as farming, timber harvest, and mining. A frequent negative affect of land disturbing activities is the elevation of water temperature resulting from reduced shading.

The North Fork of the Payette River (NFPR) between Payette Lake and Cascade Reservoir is approximately 27 km long. Although this stretch of the NFPR has the appearance of a quality trout stream, fishing has been less than satisfactory. Hatchery catchable rainbow trout are the majority of the trout harvest.

Snorkel monitoring is done annually in the McCall Subregion's anadromous fish waters as part of a statewide evaluation of anadromous fish rearing habitat. Monitoring juvenile salmonid density in fixed stream sections will provide density trends in response to changes in adult survival and/or habitat quality. Projects are underway to improve both these parameters, and presmolt density monitoring is a means of evaluating these projects' results.

OBJECTIVES

1. To determine if summer water temperatures in the North Fork Payette, Weiser, and Little Salmon rivers limit the potential of their coldwater fisheries.

2. To describe the midsummer fish community in the North Fork Payette River.

3. To determine the dispersion of hatchery rainbow trout stocked at 'limited locations near McCall.

4. To establish brown trout as an additional game fish and predator.

5. To monitor juvenile salmonid densities in fixed stream sections in the McCall Subregion to provide trend information for evaluating changes in adult survival and habitat quality.

RECOMMENDATIONS

1. Any activity which would decrease shading in the watersheds of North Fork Payette, Weiser, and Little Salmon rivers should be discouraged.

2. Programs to increase shading in the Weiser River watershed should be initiated.

3. Stocking of hatchery catchable rainbow trout should be done only in the spring and fall in the area of the Weiser River that was studied.

4. High-temperature tolerant redband trout may be considered for introduction, but it is likely that the native strain of trout in the Weiser River would recover if land and water use practices are improved.

5. The IDFG should work with the Soil Conservation Service (SCS) to encourage private landowners along the meadows area of the Little Salmon River to minimize livestock impacts to the riparian zone.

6. Find additional locations for stocking hatchery rainbow trout along the North Fork Payette River near McCall.

7. Evaluate the success of the brown trout introduction in the North Fork Payette River near McCall.

8. Annual snorkel monitoring of juvenile anadromous salmonids should be continued in established stream sections.

METHODS

Steel rods were hammered into the stream bottom at 17 sites within 3 rivers where summer water temperatures were to be monitored. A thermometer which records maximum and minimum temperatures as well as current temperature was placed in a housing and attached to the steel rod with a steel cable. Housings were placed in the river in shaded locations where water current constantly bathed them.

Thermometers were placed at seven locations on the North Fork Payette River (NFPR) between the river's confluence with the South Fork Payette River (SFPR) and Payette Lake, a distance of 120 km and an elevation range of 1,000 to 1,500 m. Additionally, Gold Fork Creek, Lake Fork Creek, and the SFPR each had one thermometer stationed near their confluences with the NFPR. Thermometers were stationed on the main Weiser River near Fruitvale and Goodrich Bridge and on the West and Middle forks of the Weiser River near their confluences with the main river. All were within an elevation range of 850 to 1,000 m. Three thermometers were stationed in the Little Salmon River in the "meadows area" between New Meadows and Round Valley Creek, where elevation ranged from 1,180 to 1,190 m.

Beginning in March and April, minimum, current, and maximum temperatures were recorded at irregular intervals of from one week to one month until August 20.

In late July when it became evident that the Weiser River and, to a lesser extent, the Little Salmon River were affected by high temperatures, one recording thermograph was stationed in each river to record the diurnal temperature regimes that occurred.

On June 29, McCall fisheries staff snorkeled and counted fish in four sections of the North Fork Payette River between the McCall Fish Hatchery and Moore Bridge. Descriptions of exact locations are filed in the IDFG Office at McCall. Each fish observed was identified as to species and length.

On July 27 and 28, McCall fishery personnel tagged three 50-fish lots of hatchery catchable trout with highly visible Floy anchor tags and released the differentially color-tagged fish in the NFPR immediately below Lardo Dam (outlet of Payette Lake), near the McCall Fish Hatchery, and at Sheep Bridge. The former two locations are within the city of McCall and the latter is one-half kilometer downriver from McCall.

On July 31, three days after stocking was complete, two divers floated from Lardo Dam downriver past the lower stocking site and recorded the location of each tagged fish observed. The color of each tag was also noted.

On five dates from May to November, age 0 brown trout were stocked in the NFPR at five locations from the McCall Fish Hatchery near Payette Lake downriver to Moore Bridge about 17 km below Payette Lake. The latter two tag groups were differentially marked with fin clips.

Methods for snorkel monitoring are described in the McCall Subregion River and Stream Investigations reports by Anderson et al. (1987a, 1987b).

RESULTS

Summer Water Temperature Monitoring

Temperatures at Site 1 near McCall (Figures 1 and 2) should be considered good for salmonids. Highest recorded temperature was 22°C and the minimum at that time was 16.5°C. At Site 2 (Figure 2), Sheep Bridge south of McCall, temperatures rose to 24.5°C between July 28 and August 20. Minimums fell to 14 and 15°C during midsummer. Similar temperatures were recorded at Site 3 (Figure 3), Moore Bridge, midway between Payette Lake and Cascade Reservoir.

At Site 4 below Cascade Reservoir, (Figure 3), midsummer minimum temperatures were 17.5°C, warmer than above the reservoir. Maximum temperatures were about the same, 22 to 24°C.

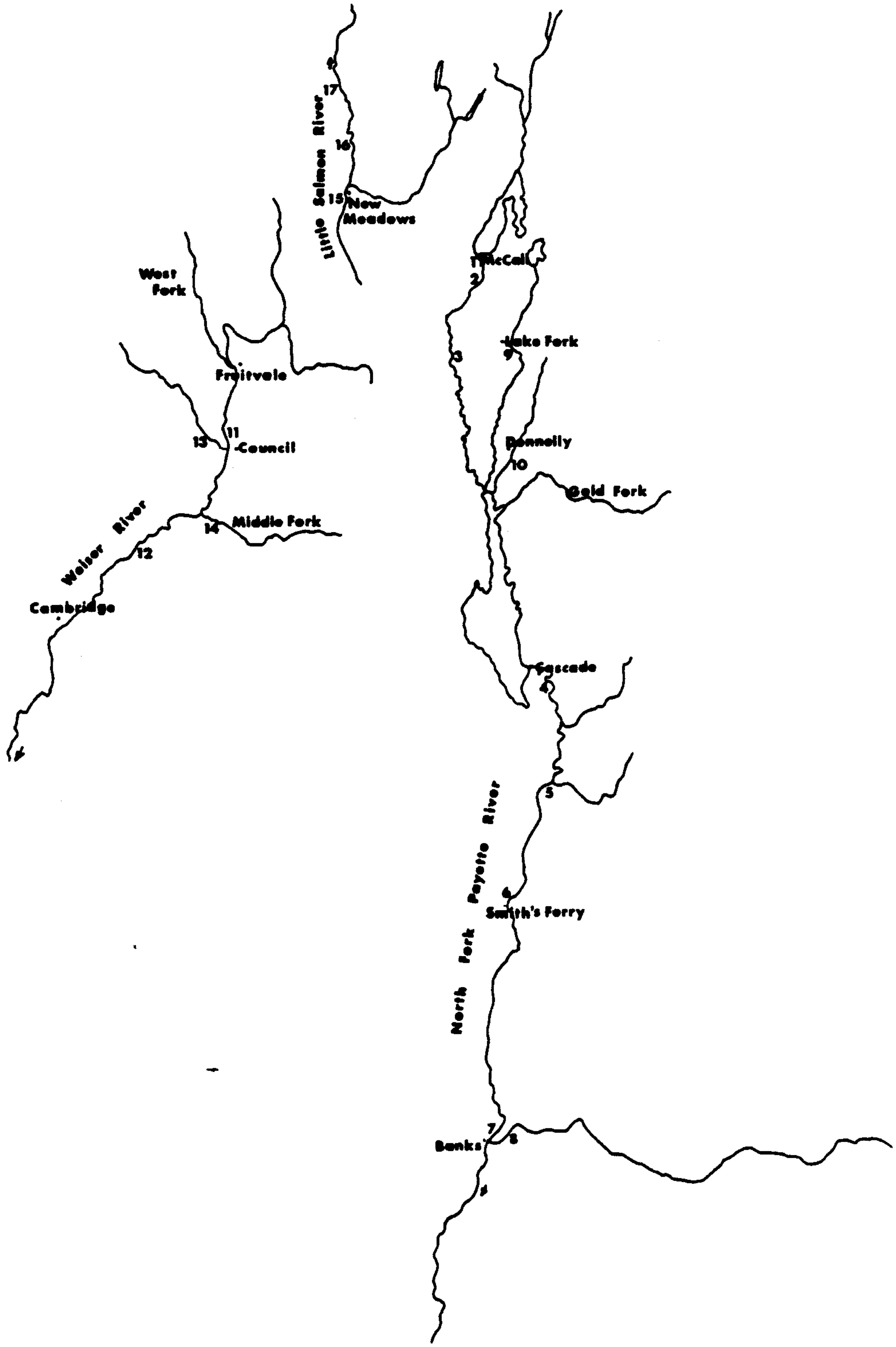

Figure 1. The North Fork Payette, upper Little Salmon, and Weiser rivers and the 17 locations where water temperatures were monitored during 1987.

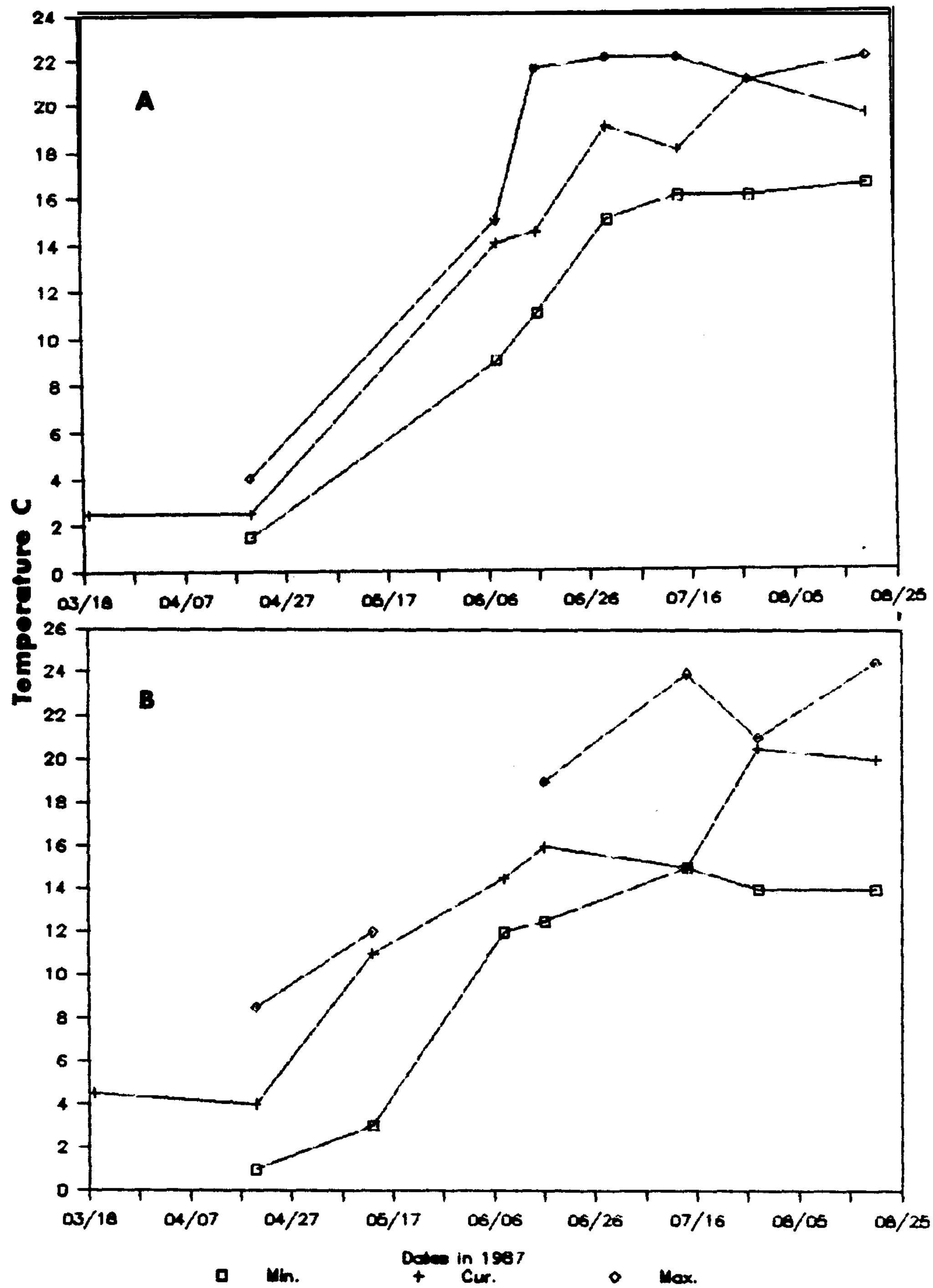

Figure 2. Maximum, minimum, and current water temperatures from March 18 to August 25, 1987 in the North Fork Payette River (A) between Payette Lake and the McCall Fish Hatchery and (B) near Sheep Bridge.

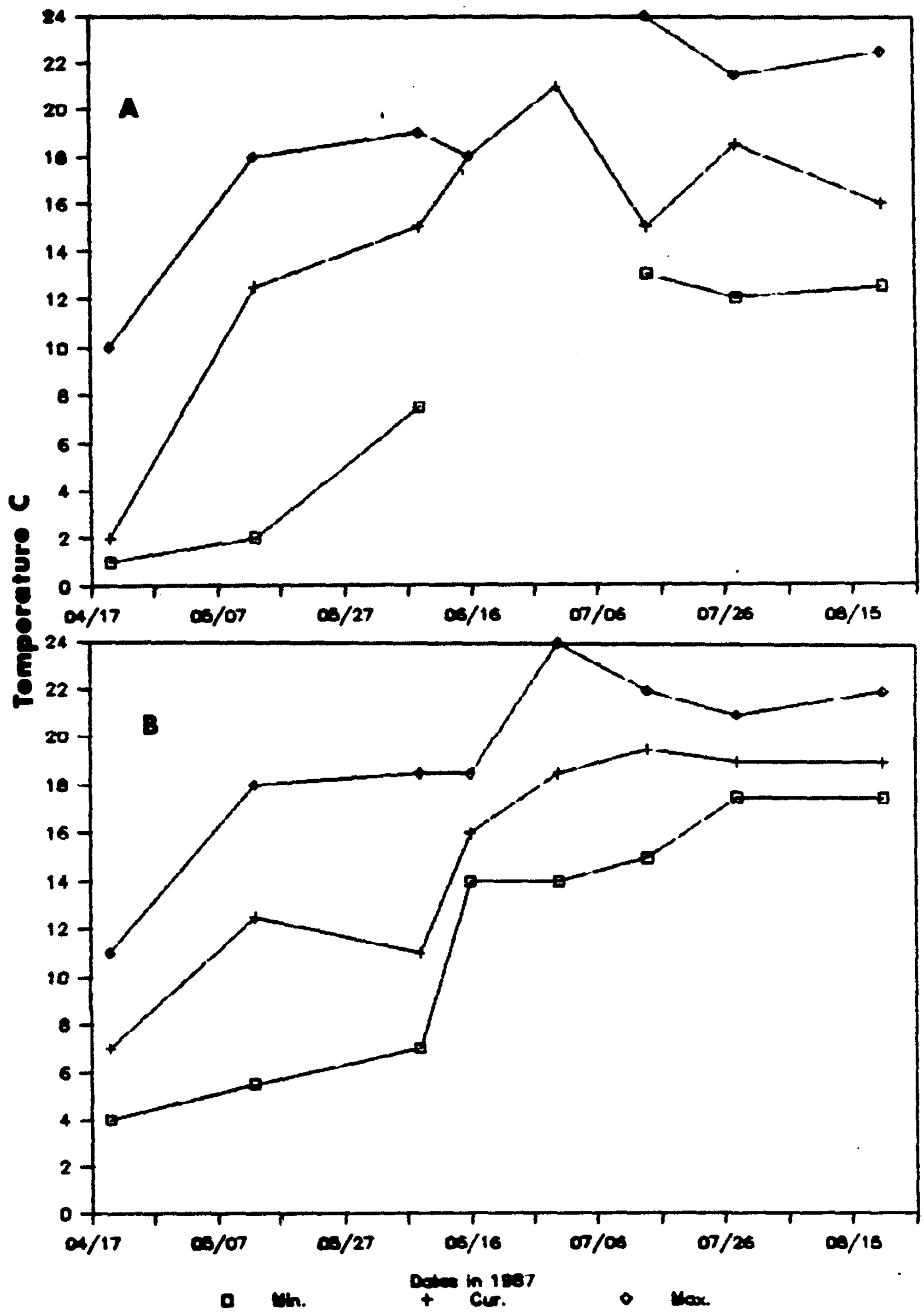

Figure 3. Maximum, minimum, and current water temperatures from April 17 to August 20, 1987 in the North Fork Payette River near (A) Moore Bridge and (B) near the Highway 55 Bridge just south of Cascade.

At Site 5 near Cabarton Bridge (Figure 4), 19 km downriver from Cascade and at the head of a 13-km roadless canyon, temperature did not exceed 22°C and minimums were 15 to 15.5°C in midsummer.

Minimum and maximum temperatures at Site 6 at the base of the roadless section (Figure 4) near the Highway 55 "Rainbow Bridge" were 1°C higher than at the Cabarton Bridge.

The thermometer at Site 7 at the mouth of the NFPR (Figure 5) was frequently affected by sediment packing around the thermometer and interfering with the maximum and minimum markers such that only current temperatures could be recorded. Midsummer current temperatures were 20.5 to 21°C. These temperatures would have been between the minimum and maximum values. The thermometer at Site 8 in the SFPR (Figure 5) had the same problem, such that frequently only the current temperature could be recorded. Current temperatures at Site 8 were always 1 to 3°C cooler than at Site 7.

Maximum temperatures at Site 9 in Lake Fork Creek (Figure 6) and at Site 10 in Gold Fork Creek (Figure 6), both tributaries to the NFPR at the upper end of Cascade Reservoir, were generally higher (up to 25°C at Site 9 and 26.5°C at Site 10) and minimums were lower than in the nearest site in the NFPR.

Although Site 1 in the Weiser River near Fruitvale, (Figure 7) is 150 m higher in elevation than Site 12 near the mouth of Goodrich Creek (Figure 7), the former site (11) experienced the highest temperature regime of any location in the three river study. By June 8, a high temperature of 23.5°C had occurred; and on July 14, July 28, and August 20, high temperatures of 30 to 30.5°C were recorded. Nevertheless, minimum temperatures during midsummer were cool, i.e., 12.5 to 14°C.

Temperatures at Site 12 were generally 2°C cooler than at Site 11. This may be because the river is considerably deeper at Site 12 and thus less affected by midday solar radiation.

Temperatures at Site 13 in the West Fork (Figure 8) and Site 14 in the Middle Fork (Figure 8) of the Weiser River were generally 3°C cooler than at Site 12 and 5°C cooler than at Site 11 of the main river.

A continuous recording thermograph was set at Site 12 on July 28 and allowed to run until August 11 (Figure 9). The thermograph could not measure temperatures above 27°C (80°F). Maximum temperatures exceeded 27°C on July 29 and 30 and again on August 4. Duration of temperature exceeding 27°C was seven to eight hours in July and three hours on August 4. Peak daily temperatures normally lasted for two to three hours where peak temperatures were recorded, i.e., at temperatures less than 27°C. Minimum daily temperatures ranged from 18 to 21°C. Temperatures were severe the last part of July, ranging from a low of 21°C to highs of 26 to 27+^{0}C for at least three consecutive days. Daily temperature ranges during the 14 days of thermograph recordings averaged 6°C.

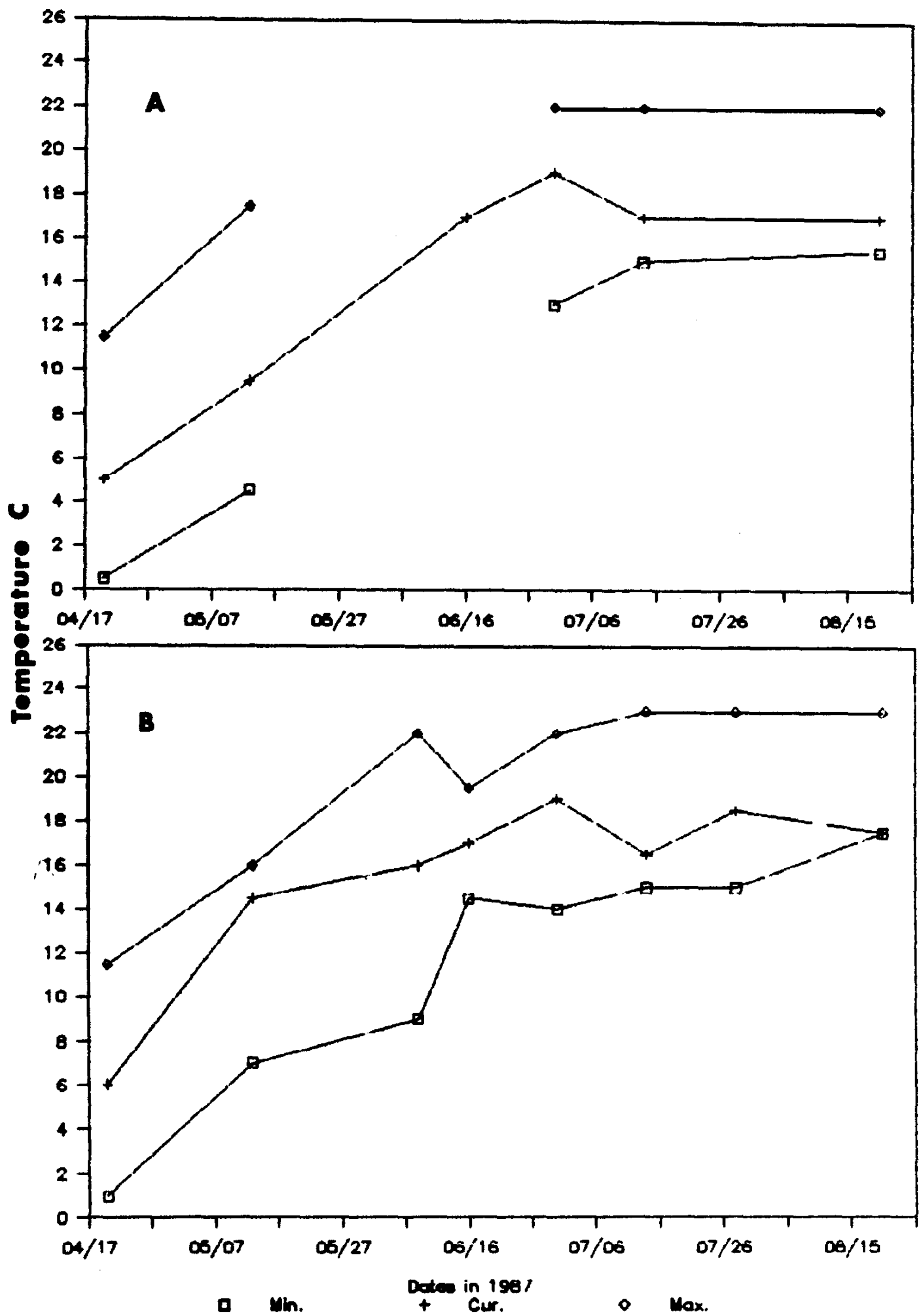

Figure 4. Maximum, minimum, and current water temperatures from April 17 to August 20, 1987 in the North Fork Payette River near (A) Cabarton Bridge and (B) Rainbow Bridge, between Cascade and Smith's Ferry.

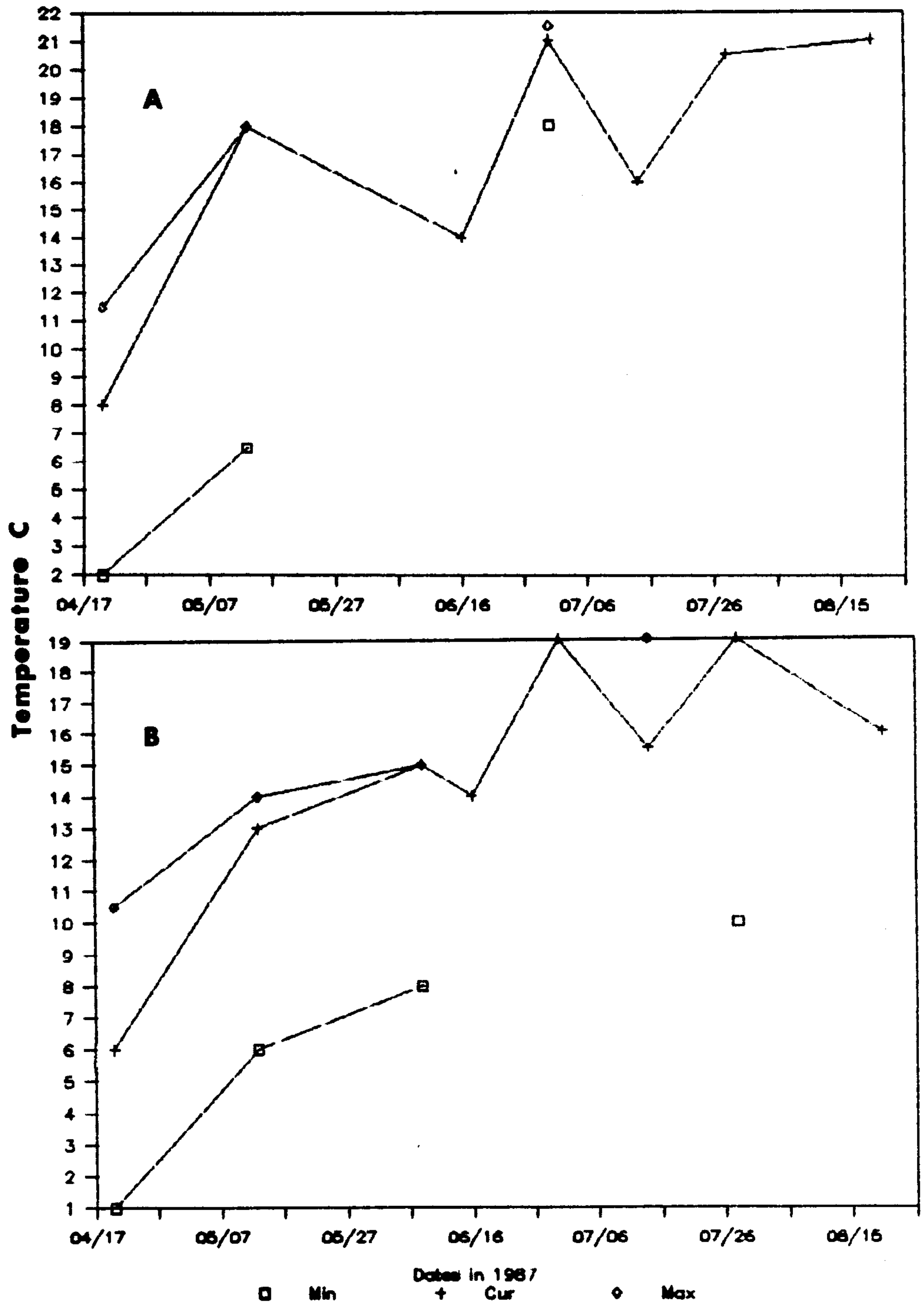

Figure 5. Maximum, minimum, and current water temperatures from April 17 to August 20, 1987 just above the mouths of (A) the North Fork and (B) the South Fork Payette River near Banks.

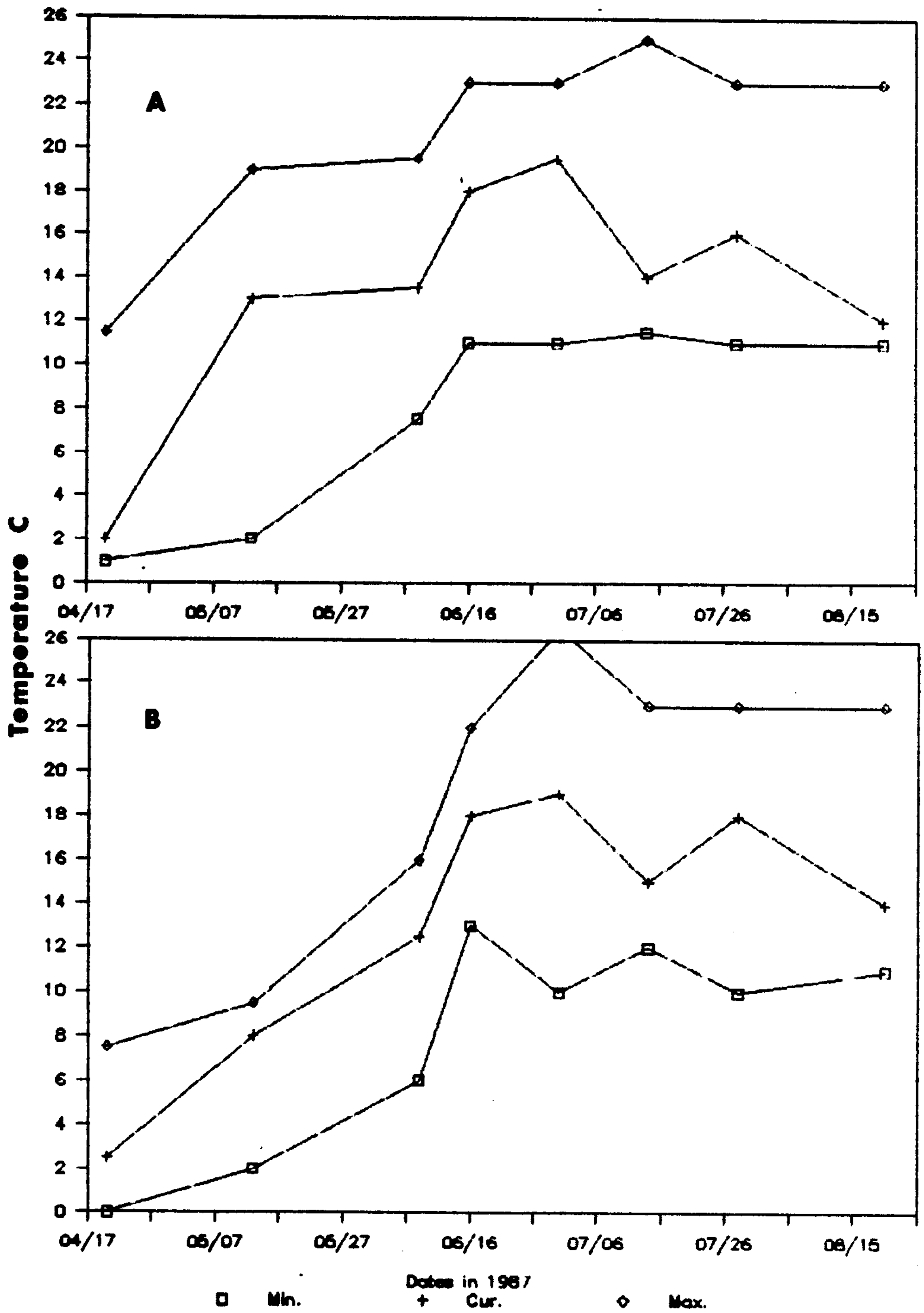

Figure 6. Maximum, minimum, and current water temperatures from April 17 to August 20 in lower (A) Lake Fork Creek and (B) Gold Fork Creek, tributaries to the North Fork Payette River at Cascade Reservoir.

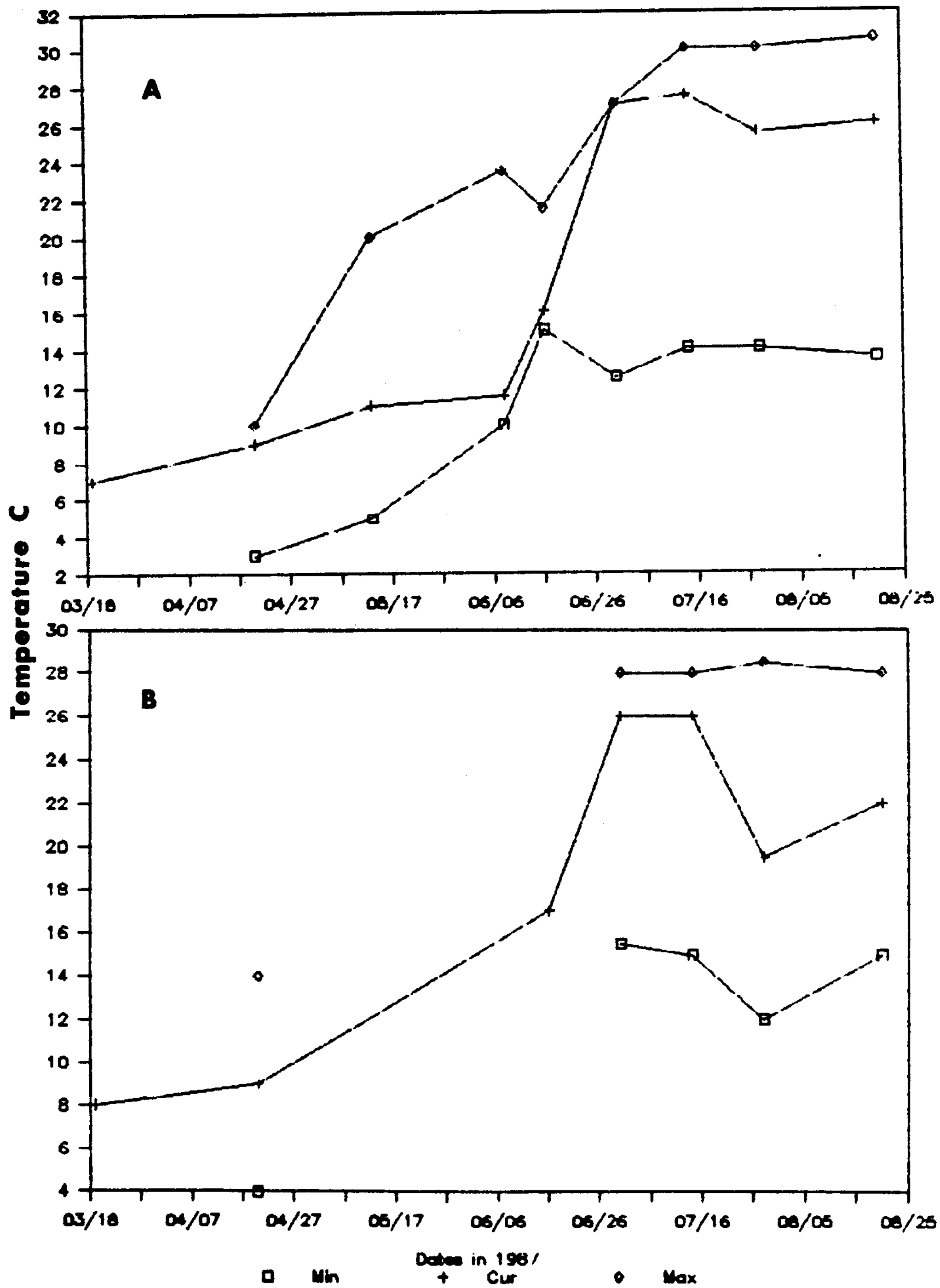

Figure 7. Maximum, minimum, and current water temperatures from March 18 to August 20, 1987 in the Weiser River near (A) Fruitvale and (B) Goodrich Bridge.

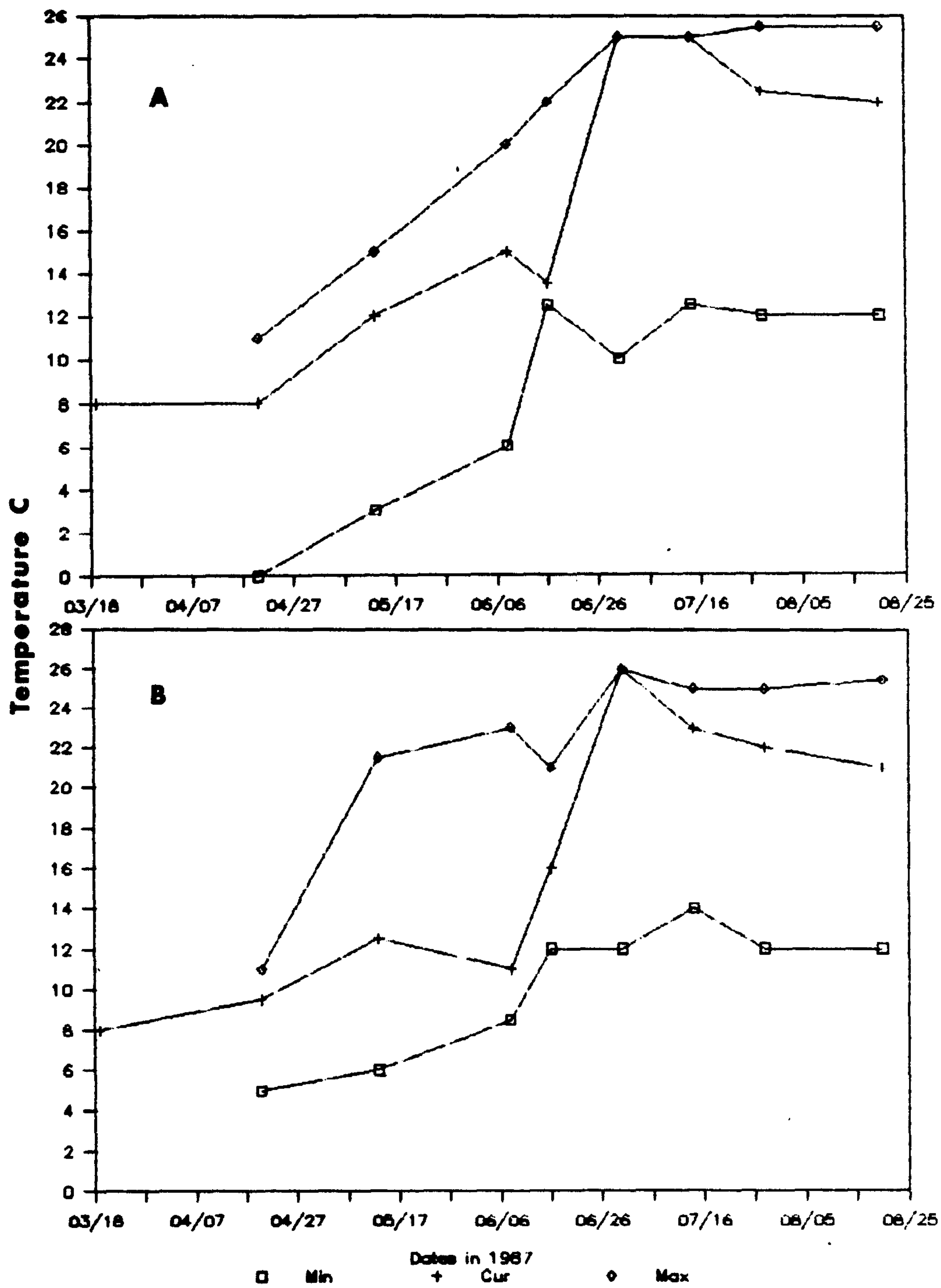

Figure 8. Maximum, minimum, and current water temperatures from March 18 to August 20, 1987 in the lower (A) West Fork and (B) Middle Fork of the Weiser River.

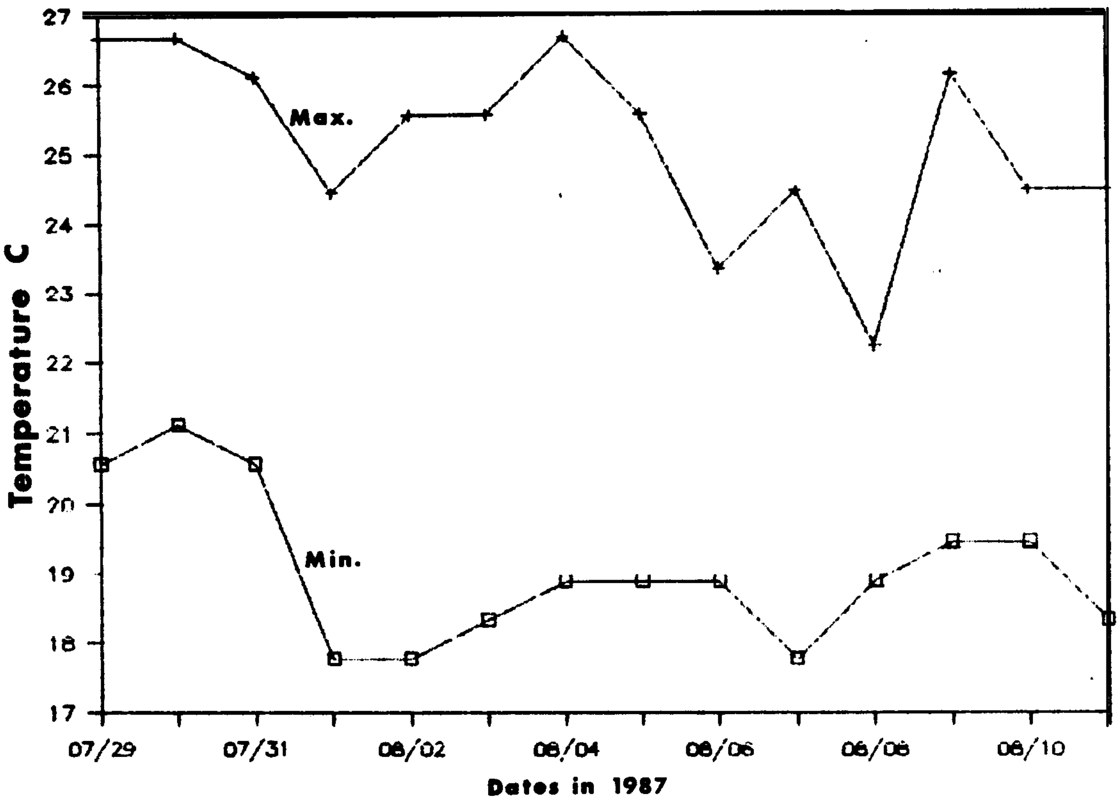

Figure 9. Daily maximum and minimum water temperatures from July 29 to August 11, 1987 in the Weiser River near Goodrich Bridge.

In general, maximum water temperatures in the Little Salmon River were less than those in the Weiser River and more than those in the North Fork Payette River. Maximum temperatures at Site 15 near New Meadows (Figure 10); at Site 16, 3 km north near Kimberland Meadows (Figure 10); and at Site 17 at the lower end of the meadows (Figure 11) were similar, i.e., 26 to 27°C. Midsummer minimum temperatures at the lower site (17) were generally 1°C, or more, higher than at the other two sites. This may be due to increased radiation received as the stream meanders through the mostly unshaded valley and to the addition of water from thermal springs 2 to 3 km upriver from Site 17.

A thermograph was stationed at Site 17 from July 28 through August 8 (Figure 12). Maximum daily temperatures were 26°C in late July and decreased to near 21°C by August 8. Daily minimum temperatures ranged from 14 to 19°C. Average daily temperature range was 7°C. Daily temperature peaks lasted for one to three hours before declining.

North Fork Payette River Fisheries

Most of the fish observed in the four snorkel counts in the North Fork Payette River between Cascade Reservoir and Payette Lake (Figure 13) were small dace, shiners, and juvenile whitefish. Sculpins were present also but they occupy the interstitial spaces between the bottom rocks and were not countable (Table 1). Of 4,297 fish counted, there were only 3 natural and 8 hatchery rainbow trout observed. Two of the three natural rainbow trout were juveniles, 8 to 15 cm long. This is a density of 0.03 juvenile rainbow trout/100 m^2, an extremely low value (see the snorkel count section for comparative values), especially for a river that is the major spawning area for 6,070-hectare Cascade Reservoir.

Table 1. Snorkel densities (numbers/100 m^2) of rainbow trout, whitefish, dace, squawfish, suckers, and shiners in the North Fork of the Payette River, June 29, 1987.

Location	Wild rainbow Juv.	Wild rainbow Adult	Hatchery rainbow	Whitefish Juv.	Whitefish Adult	Dace	Squaw-fish	Suckers	Shiners
Hatchery	-	-	0.4	0.3	0.2	15.	-	-	-
Sheep Br	0.1	-	-	16.9	8.4	-	0.3	-	56.3
Swallow H.	-	-	-	26.0	1.0	-	0.6	-	86.6
Hartsell Br		0.1	0.1	2.9	0.9	-	3.4	7.3	73.0

Of the 150 color-coded tagged rainbow trout stocked in the NFPR at the normal stocking locations of Lardo Dam, McCall Fish Hatchery, and Sheep Bridge, 44 (29%) were observed by divers 3 days after stocking (Table 2).

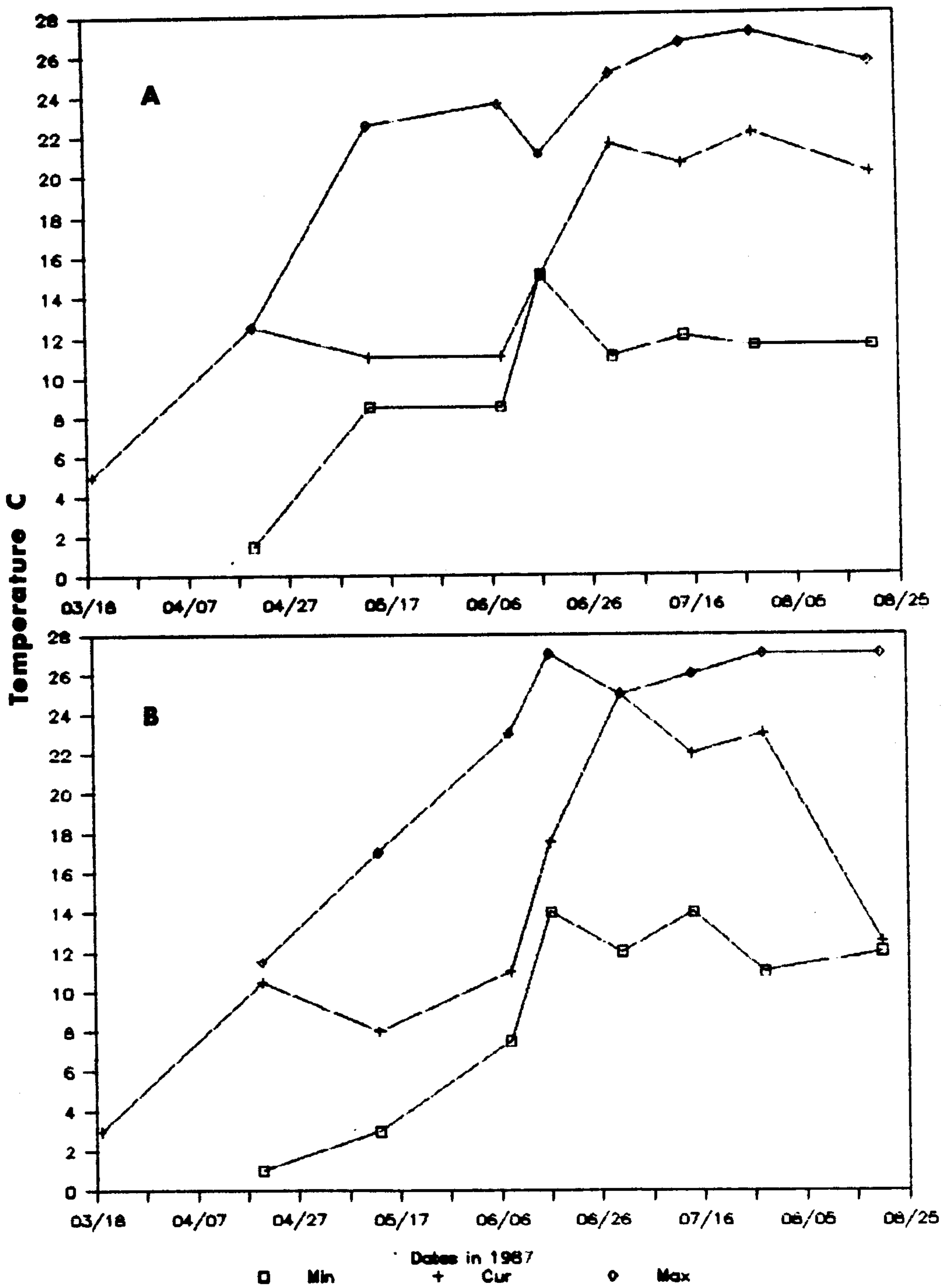

Figure 10. Maximum, minimum, and current water temperatures from March 18 to August 20, 1987 in the Little Salmon River (A) near New Meadows and (B) 3 km north near Kimberland Meadows.

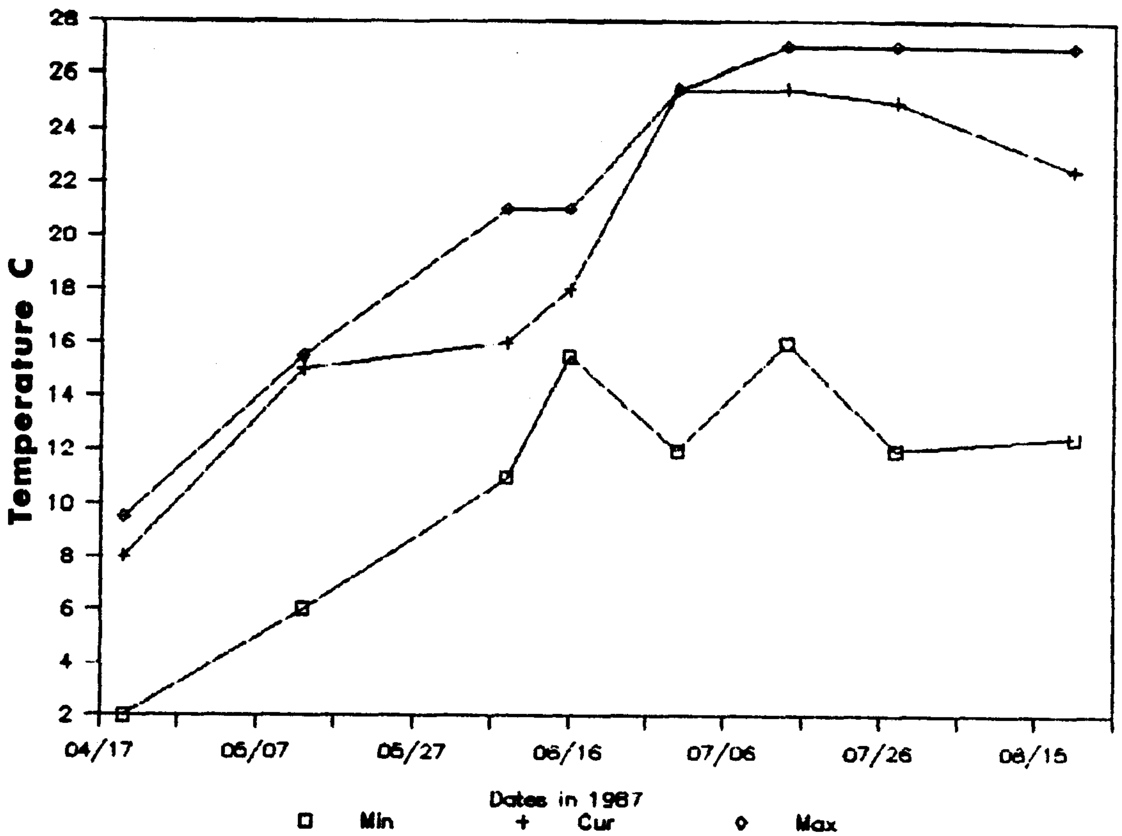

Figure 11. Maximum, minimum, and current water temperatures from April 17 to August 20, 1987 in the Little Salmon River above the mouth of Round Valley Creek.

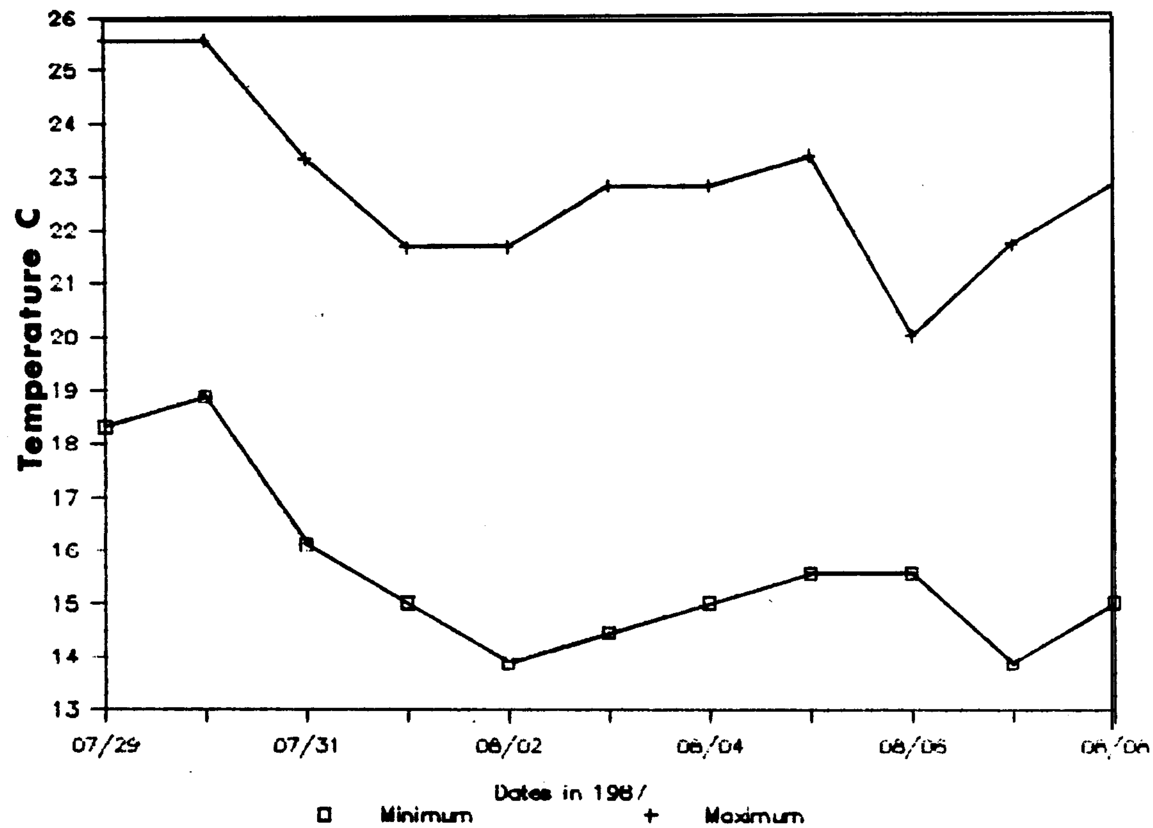

Figure 12. Daily maximum and minimum water temperatures from July 29 to August 8, 1987 in the Little Salmon River near Round Valley Bridge.

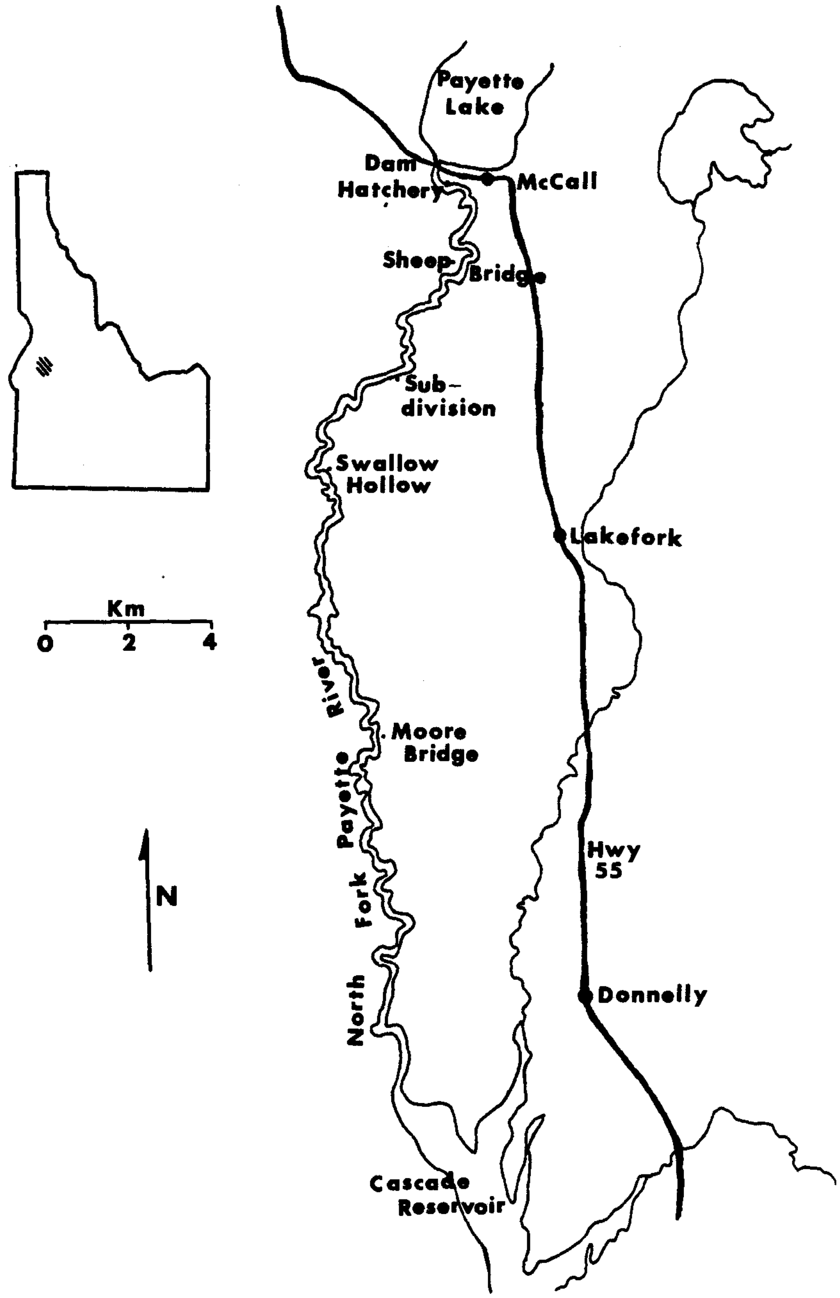

Figure 13. The North Fork Payette River from Payette Lake to Cascade Reservoir.

Table 2. Tagged trout observed on July 31, 1987 in the North Fork Payette River three days after stocking. Orange, yellow, and white tags were released at Lardo Dam, McCall Fish Hatchery, and Sheep Bridge, respectively.

Location of observations	Orange	Yellow	White
Long pool below Lardo Dam	18	1	0
Near McCall Hatchery	0	5	0
500 m below hatchery	0	4	0
Sheep Bridge	0	0	16

No downstream movement was noted for fish released immediately below Lardo Dam. Ten percent of observed tags from those released at the hatchery had moved up to Lardo Dam (approximately 500 m) and 40% had moved downriver as much as 500 m. No tagged fish were observed in the 3 km between this point and Sheep Bridge. Tagged fish released at Sheep Bridge were observed only at Sheep Bridge.

The 3-km river reach between the McCall Hatchery and Sheep Bridge release sites is not benefiting as much as it should from hatchery fish stocking due to the sedentary nature of the stocked fish. Additional stocking locations should be found in this river reach.

A total of nine orange, nine yellow, and seven white tags were returned to the IDFG, indicating that **a** similar exploitation rate was occurring on fish released at each of the three release sites.

Brown trout were stocked five times between May 28 and November 2, 1987 (Table 3). All were domesticated Plymouth Rock strain. Stocking locations were at the McCall Fish Hatchery, Sheep Bridge, Payette River Subdivision, Swallow Hollow, and Moore Bridge. Although this is a massive number of fish to stock in this small river, all were age 0 and a large natural mortality rate is expected.

Table 3. Brown trout stocked into the North Fork of the Payette River between Cascade Reservoir and Payette Lake in 1987.

Date	Number	Mean length (cm)	Comments
May 28	188,000	5.1	
July 9	25,000	8.7	
August 25	7,500	11.2	
September 23	7,500	13.3	Adipose clip
November 2	4,068	15.2	R. pelvic clip

Snorkel Monitoring of Juvenile Salmonid Densities

Annual density estimates of juvenile rainbow-steelhead trout, juvenile chinook salmon, and cutthroat trout are presented from 1984 to the present. South Fork Salmon River (SFSR) data are available from 1984 (Table 4); Middle Fork Salmon River (MFSR) data are available from 1985 (Table 5); and new transects were initiated in Big Creek, tributary to the MFSR, and the Secesh River, tributary to the SFSR.

Table 4. Density (numbers/100 m^2) of juvenile rainbow-steelhead trout (age 1 and older), chinook salmon (age 0), and all sizes of cutthroat trout in the South Fork Salmon River (SFSR) and tributary snorkel transects from 1984 through 1987.

Snorkel	Steelhead trout				Chinook salmon				Cutthroat trout			
Section	1984[a]	1985[a]	1986	1987	1984	1985	1986	1987	1984	1985	1986	1987
Main stem SFSR												
5	1.4	0.8	0.8	1.4	13.2	18.5	26.2	97.3	0	0	0	0
7	3.1	0.9	2.7	0	5.1	1.4	27.5	2.1	0	0	0	0
11	2.5	2.7	1.5	0	13.5	15.1	17.7	0.2	0	0.09	0	0
14	0.9	0.1	0.1	0	7.6	2.5	15.3	0.2	0	0	0	0
16	0.9	0.3	1.7	0.5	1.7	2.6	11.9	0.3	0	0	0	0
18	0.03	0	0	-	1.5	<0.1	0	-	0	0	0.07	-
19	1.9	2.0	2.7	2.1	2.2	0.5	1.5	1.3	0	0	0.06	0
20	0.7	2.5	3.3	1.9	2.1	2.1	4.2	12.9	0	0	0	0
21	2.1	1.5	0.9	2.1	0.8	0.5	0.2	1.3	0.03	0.03	0	0
22	0.8	0.2	1.0	0.5	1.2	0.0	0.7	2.8	0.24	0.04	0.1	0.02
24	0.1	0.2	0.5	0.2	0	0	<0.0	0	0	0.05	0.1	0
25	1.9	0.6	3.4	1.4	0.1	0.2	0.8	0.4	0.07	0.06	0.13	0
26	1.3	2.4	2.4	2.4	0.1	0.3	0.9	0.6	0.03	0.06	0	0
28	0.3	0.5	0.3	0.4	0.3	<0.1	0.1	0	0.19	0.18	0.14	0
Means	1.3	1.1	1.5	1.0	3.5	3.1	7.7	9.2	0.04	0.04	0.04[b]	-
Std Err	0.3	0.3	0.3	0.3	1.3	1.6	2.7	7.4	0.02	0.02	0.01[b]	-
SFSR Tributaries: East Fork												
3	4.8	3.7	8.9	9.2	0	9.2	8.9	2.8	-	-	-	-
6	1.1	0.3	2.3	0.6	3.6	2.5	10.3	1.7	-	-	-	-
7	3.2	2.7	3.6	4.9	0.7	0.9	0.2	4.7	-	-	-	-
Means	3.0	2.2	4.9	4.9	1.4	4.2	6.5	3.1	-	-	-	-
Std Err	1.1	1.0	2.0	2.5	1.1	2.5	3.2	0.9	-	-	-	-
SFSR Johnson Creek												
L-2	-	-	3.3	3.5	-	-	8.5	7.3	-	-	-	-
L-3	-	-	2.7	2.6	-	-	7.6	12.2	-	-	-	-
Means	-	-	3.0	3.0	-	-	8.1	9.7	-	-	-	-
Std Err	-	-	0.3	0.5	-	-	0.5	2.4	-	-	-	-

[a]Data from 1984 and 1985 from Thurow (1987).
[b]Mean and (Std Err)=0.001 (0.0015).

Although it appears that density of chinook salmon juveniles has been increasing, the large standard errors indicate the confidence intervals would overlap considerably among annual estimates. The mean annual estimate of cutthroat trout density decreased to 3% of the four-year average, even though cutthroat have been protected with a catch-and-release regulation since 1986.

Table 5. Density (numbers/100 m^2) of juvenile rainbow-steelhead trout age 1 and older and chinook salmon age 0 in snorkel transects of the Middle Fork Salmon River from 1985 through 1987.

Snorkel	Steelhead trout			Chinook salmon		
sections	1985	1986	1987	1985	1986	1987
Big Cr.-1	1.7	6.6	0	7.7	21.5	0.7
Marble Cr.-1	2.7	12.5	3.1	0	0	0
Marble Cr.-2	0.8	0.4	0.4	0	0	0
Mean	1.8	6.5	1.0	0	0	0
Standard Error	1.0	6.1	1.4			
Monumental Cr.-1	1.1	0.2	6.1	0	0	0
Monumental Cr.-2	5.0	5.9	5.6	3.2	0.2	0
Monumental Cr.-3	4.8	4.1	7.9	6.1	0.5	0
Monumental Cr.-4	2.5	2.1	2.1	40.0	16.5	114.4
Monumental Cr.-5	0.4	2.4	5.5	12.3	30.0	44.6
Mean	4.8	2.9	5.4	12.3	9.4	31.8
Standard Error	2.6	1.0	0.9	7.2	6.0	22.4

Densities of steelhead trout and chinook salmon increased in 1987 in Monumental Creek, and densities of steelhead decreased in Big Creek and Marble Creek. None are statistically different, however. Numbers of steelhead and chinook were drastically reduced in 1987 at Big Creek-1. In October 1986, the upper part of this snorkel section was illegally channelized, and during the 1987 snorkel survey it was observed that the quality of the stream bottom was greatly reduced, as was stream depth. Additionally, the only significant pool habitat in the section had been destroyed.

Snorkel monitoring was initiated at four other sections on Big Creek in 1987 (Table 6). These are snorkel sections: 12, below the mouth of Beaver Creek; 13, below the mouth of Little Ramey Creek; 14, upstream from Hard Boil Bar; and 15, between the mouths of Garden and Cave creeks. Average densities of steelhead and chinook were higher in these sections than in Section 1.

Table 6. Densities (numbers/100 m^2) of rainbow-steelhead trout age 1 and older, age 0 chinook salmon, and all ages of cutthroat trout in four new (1987) snorkel sections in Big Creek.

Snorkel section	Steelhead trout	Chinook salmon	Cutthroat trout
Big Cr.-2	0.9	4.8	0.2
Big Cr.-3	0.2	7.7	0.9
Big Cr.-4	0.4	0.3	0.1
Big Cr.-5	0.8	0.1	0.6
Means	0.6	3.2	0.5
Standard Error	0.2	1.8	0.2

Snorkeling was also initiated on the Secesh River, tributary to the SFSR. Five locations were established from upper Lake Creek, tributary to the Secesh River, down to the lower end of Secesh Meadows. These snorkel sections were: 11, Secesh River above Long Gulch Bridge; 12, Secesh River at Upper Secesh Meadows; 13, Secesh River above Grouse Creek Bridge; 14, Lake Creek above the bridge at Burgdorf; and 15, Lake Creek above the mouth of Willow Creek (Table 7).

Table 7. Density (numbers/100 m^2) of juvenile rainbow-steelhead trout age 1 and older and age 0 chinook salmon at five snorkel sections on the Secesh River and tributary, Lake Creek.

Snorkel section	Steelhead trout	Chinook salmon
Secesh-1	3.1	41.6
Secesh-2	2.5	40.8
Secesh-3	3.4	5.6
Lake Cr.-1	4.9	39.2
Lake Cr.-2	0.6	15.2
Mean	2.8	28.5
Standard Error	0.7	7.5

DISCUSSION

Temperature data were collected in mid-elevation rivers of the McCall Subregion to see if summer temperatures were limiting salmonid production. Species of concern are rainbow (and redband) trout (Salmo gairdneri), mountain whitefish (Prosopium williamsoni), and brown trout (S. trutta). A summary of literature in Calhoun (1966) indicates that trout can survive for one or two days in 80°F (27°C) water and have been known to survive for two weeks at temperatures of 73 to 74°F (23°C). It is further stated that rainbow trout can tolerate water temperatures from 32 to 80°F. However, they prefer temperatures below 70°F (21°C). Other work reported in Calhoun (1966) indicates that the upper temperature tolerated by rainbow trout varies from the mid-70s to mid-80s°F, depending on the oxygen content of the water, size of fish, and the degree of acclimation. Further, Calhoun (1966) states that the duration of high temperatures must be known to evaluate trout habitat. High midday temperatures need not kill fish if the water cools at night and morning.

Redband trout, which until recent years was considered a rainbow trout, is generally thought to withstand higher temperatures than rainbow trout. Although Behnke (1979) proposed a broad concept of redband trout which includes all inland populations of rainbow trout-like salmonids including California golden trout, Canadian Kamloops, and some inland steelhead populations, the redband trout of concern in this report is that frequently described as an isolated group of non-anadromous trout populations found in desiccated basins of southern Oregon and adjacent arid regions of California, Nevada, and Idaho that are capable of dealing with low stream flows and high temperatures (Wishard et al., unpublished data). Sonski (unpublished) determined upper lethal temperatures (LT50) for redband trout by acclimating them to 15, 20, and 23°C, then subjecting them to temperature increases of 0.5°C daily until death. LT50s ranged from 25.5 to 27.7°C (80 to 82°F). Unfortunately, this experiment did not allow for a diurnal temperature regime that would normally occur. The inherent thermal resistance of redband trout is likely its ability to tolerate daily temperature extremes rather than sustained high temperatures.

Specific information on temperature tolerances of mountain whitefish was not available to the author; however, McAfee (1966b) states that high water temperatures limit the downstream distribution of mountain whitefish in California, Nevada, and Utah to 4,500 ft. (1,372 m).

Brown trout are reputed to be more tolerant of warm water than are rainbow trout; however, the evidence of this is not conclusive. Frost and Brown (1967) present data showing that brown trout acclimated at 73°F had LT50s 82, 80, 79.5, and 77.5°F when held at these temperatures for 12 hours, 24 hours, 48 hours, and 7 days, respectively. These authors also stated that although brown trout can survive for brief periods at temperatures exceeding 80°F (27°C), they do not grow successfully at temperatures much exceeding 68°F (20°C).

Turner (1972) in his literature review of brown trout found that exposure of brown trout to high water temperatures, while not lethal, has an accumulated effect which can prove detrimental if the trout can not spend several hours daily in water less than 70°F. Turner additionally noted that brown trout can withstand temperatures above 80°F (27°C) for short periods. Brown trout growth was greatest at water temperatures between 45 and 66°F (7 and 19°C). Additionally, younger brown trout (age 0) could not tolerate as high a temperature as older (parr) ones, i.e., 26 versus 29°C mean lethal temperatures, respectively. If there is a meaningful difference between the upper temperature tolerances of rainbow, redband, and brown trout, the above information does not provide it. Upper temperature maxima for these species might be best described as that which does not exceed the low 80s°F and must drop considerably below this on a nightly basis. Additionally, extended periods (several days or weeks) of such high temperature regimes would likely favor other fish species, e.g., minnows, which would tie up most of the potential productivity of the water.

Most of the North Fork Payette River between Cascade Reservoir and Payette Lake is bordered by private lands, and there is only an occasional road reaching the river banks. Most fishing occurs near McCall, i.e., between Lardo Dam and the fish hatchery, within 500 m up and downriver from Sheep Bridge and near the Payette River Subdivision. Thus, the hatchery catchable rainbow trout, most of which are stocked at the above three locations, are able to satisfy much of the fishing demand.

Fishing pressure could be dispersed and more fishing effort supported if more access and stocking sites were identified, especially in the McCall area. Chapman (1983) stated that trout stocked downriver from Sheep Bridge were returned to the creel at a much lower rate than those stocked at Sheep Bridge and upriver, <2.5% and >9%, respectively. This may be due to much less fishing effort because of poor access in the lower reach of the river, although Chapman attributed it at least in part to high summer water temperature and lower stream quality in the lower reach. Water temperature information collected in 1987 (see water temperature section in this report) does not demonstrate a significant difference in summer temperatures between the area near McCall and that lower in the reach above Cascade Reservoir. Chapman also stated that stocked trout dispersed more when stocked early during high, cooler water than later in the summer when discharge was less and water temperature warmer.

The way to access most of the river is with a raft or canoe and this seldom occurs. Even for those who do float the river, however, trout fishing is considered poor except during the spawning migration out of Cascade Reservoir. Upriver from Hartsell Bridge, fishing is closed during this period to protect spawning rainbow trout.

From the late 1950s through the 1960s, the NFPR was treated annually with either Squoxin or rotenone to kill squawfish which migrated up from Cascade Reservoir to spawn. Although it was assumed that most of the rainbow trout spawned in tributary streams (Richards, 1961, IDFG file memorandum) and not the NFPR itself, the rotenone applications may have had a significant negative effect on the native rainbow trout population of the NFPR.

Irrigation withdrawals from the NFPR as well as the nearby tributaries of Lake Fork and Gold Fork also have negative effects on trout populations. Postspawning adults and fry are lost into irrigation ditches, and the stream channel is reduced to low flows through most of the summer. This results in elevated water temperature, reduction in cover and food from streamside vegetation, and reduction in cover afforded by greater water depth. In early June 1986, manipulation of water flow at Lardo Dam by irrigation officials reduced discharge from over 1,000 cfs to 26 cfs overnight and to 19 cfs shortly afterward. This certainly affected the rainbow trout eggs and alevins which would have been in the spawning gravel and unable to escape. This may have been the reason so few yearling rainbow trout were observed in the snorkel transects in July 1987.

Brown trout may have some advantage over rainbow trout in this river, however, as flow extremes are much less during the winter when brown trout eggs and alevins are in the gravel than during spring and early summer when rainbow trout young are in the gravel.

Brown trout were introduced into the NFPR in hope that they would be successful in forming a population of trout which would live in the river (rather than Cascade Reservoir), develop a fishable population, and make use of the abundant small forage fish. Because brown trout are late-fall spawners, their eggs may hatch and their fry be out of the gravel during a time when irrigators are not manipulating water levels. Also, brown trout may tolerate slightly higher water temperatures than rainbow trout, a characteristic which may benefit them in the NFPR.

To enhance survival, stocking densities should be considered in future stocking of juvenile brown trout. Hume and Parkinson (1987) found that survival and, to a lessor extent, growth of steelhead fry were reduced by high density because the stocked fry did not move into adjacent vacant areas. For point-released fry, median dispersal distances over the summer were typically <100 m and densities remained high near the stocking location. Hume and Parkinson further recommended that stocking sites should be less than 500 m apart in order to fully utilize the capacity of the stream. Recommended stocking densities should be between 0.3 and 0.7 fry per m^2.

Water chemistry in the North Fork Payette River may negatively impact the introduced brown trout. Frost and Brown (1967) state that, "There is an association between geological formations and size and growth rates of trout living in the waters above them. In general, growth is good in hard, alkaline waters and it is poor in soft, acid waters.... There is a threshold of hardness at about 150 ppm of calcium carbonate, above which trout may grow at maximal rates, but below which they are limited in their early growth...." Alkalinity was 16 mg/1, hardness 9 mg/l, and pH 6.6 in the NFPR at Swallow Hollow on July 20, 1987. This may be an unusually low level of pH, however, since the Idaho Department of Health and Welfare (Clark and Wroten 1975) recorded an average of five monthly pH samples in this area of the NFPR at 7.6 with a range of 7.4 to 7.8. Thus, pH may be conducive to good brown trout growth, but the alkalinity and hardness are very low. Hopefully, the artificial enrichment from the McCall domestic waste effluent and that from the McCall Fish Hatchery will create enough biological production to compensate for the low level of inorganic nutrients.

The variation in densities of salmonids observed by snorkeling between sections in **a** river precludes detecting significant differences between years by simply comparing mean values from year to year. The data in this report, however, are also being used by Charlie Petrosky in a statewide analysis of juvenile density monitoring, and he will consider the effects of different stream channel and gradient types as well as differences observed between years on the density of juvenile salmonids.

Density of cutthroat trout was examined in the SFSR and Big Creek. The SFSR has been managed for catch-and-release trout fishing since 1986 to protect cutthroat trout and juvenile steelhead. There is limited evidence that the SFSR used to support a large cutthroat trout population prior to intense mining operations in the early 1900s, and catch-and-release is being used to allow the limited numbers of cutthroat which still inhabit the SFSR to rebuild the population. There is no indication that that program has increased the number of cutthroat trout yet, but five years would probably be necessary before an increase in age 1 and older cutthroat trout would be noticeable in snorkel counts. Average number of cutthroat trout in the SFSR over the last four years is 0.03/100 m^2, and the 1987 estimate was 0.001/100 m^2. Mean cutthroat trout density in the new sections (lower, roadless area) of Big Creek, which always has had a sizeable cutthroat population and was put on catch-and-release regulations in 1984, is 0.5/100 m^4, 16 times greater than the four-year average density in the SFSR.

JOB PERFORMANCE REPORT

State of: **Idaho**

Name: **REGIONAL FISHERY MANAGEMENT INVESTIGATIONS**

Project No.: **F-71-R-12**

Title: **McCall Subregion Technical Guidance**

Job No.: **3(MC)-d**

Period Covered: **July 1, 1987 to June 30, 1988**

ABSTRACT

McCall Subregion fishery management personnel responded to 203 requests and opportunities for technical input. Comments were provided to state and federal agencies on proposed activities for which they have regulatory authority. Advice and technical assistance were provided for private businesses and the public on activities associated with fish, or having impacts on fish populations or fish habitat. The major topics of involvement included stream channel alterations, mining, and land management planning.

We also gave presentations to schools, sportsperson groups, and civic organizations. We answered many questions from the angling public on fishing opportunities, regulations, techniques, and specific waters.

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OBJECTIVES

1. To protect or minimize impacts to McCall area fisheries by providing technical fisheries input to government agencies with regulatory or land management authority.

2. To provide technical fisheries input, guidance, and advice to private entities and the general public.

3. To promote understanding of the environmental requirements of fish populations and appreciation of their values.

RECOMMENDATIONS

1. Continue to provide technical fisheries input to the entities which most affect fish populations.

2. Continue to provide technical guidance and advice to private interests and the general public.

3. Expand efforts to educated the public in the environmental requirements for fish.

RESULTS

The following Table (1) lists the public and private entities and number of contacts and responses made for each during 1987.

Table 1. Summary of technical guidance responses and activities by McCall Subregion fisheries management personnel in 1987.

Agency or individuals	Number of responses
U.S. Forest Service	95
U.S. Bureau of Land Management	3
U.S. Environmental Protection Agency	2
U.S. Army Corps of Engineers	3
U.S. Soil Conservation Service	3
Idaho Department of Water Resources	28
Idaho Department of Lands	19
Idaho Department of Health & Welfare	4
Idaho Department of Transportation	2
Idaho Outfitters & Guides Board	6
Municipalities	3
Hydroelectric developers	18
Private fish pond owners	6
Public meetings and presentations	11
Total	203

JOB PERFORMANCE REPORT

State of: **Idaho** **Project** **Name:** **REGIONAL FISHERY MANAGEMENT INVESTIGATIONS**

No.: **F-71-R-12** **Job No.:** **3(MC)-e** **Title:** **McCall Subregion Salmon and Steelhead Investigations**

Period Covered: **July 1, 1987 to June 30, 1988**

ABSTRACT

Region 3 (MC) salmon and steelhead investigation data are incorporated in a separate, statewide "Salmon and Steelhead Investigations" report.

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